SWATERRESOURCES ABSTRACTS



VOLUME 18, NUMBER 1 JANUARY 1985

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey U.S. Department of the Interior

VOLUME 18, NUMBER 1 JANUARY 1985

W85-00001 -- W85-00507



The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

S elected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific Information Center U.S. Geological Survey MS 425 National Center Reston, VA 22092

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

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ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

ANALYSIS OF CILIATA FROM POLLUTED SECTOR OF THE RIVER DRWINKA ON THE BASIS OF BINARY DATA,

Jagiellonian Univ., Krakow (Poland). Dept. of Hydrobiology.

K. Wiakowski.

Acta Hydrobiologica, Vol. 23, No. 4, p 319-329, 1981. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *River Drwinka, *Poland, *Water pollution effects, *Protozoa, Population dynamics, Species diversity, Water quality, Bioindicators.

In the course of two seasons (1978 and 1979) 68 samples were collected in the polluted sector of the river Drwinka. The Ciliata fauna was distinctly the collected in a linear way, in agreement with samples were collected in the polluted sector of the river Drwinka. The Ciliata fauna was distinctly differentiated in a linear way, in agreement with the pollution gradient. The food spectrum of Ciliata also changes at particular sampling stations in a linear way. A gradually decreasing participation of bacteriophagous forms at a concomitant increase in participation of species feeding on algae. Among the species characteristic of the most poluted station, 1, were: Metopus es, M. contortus, Plagiopyla nasuta, Caenomorphia medusula, and Colpidium campylum, C. colpoda, Paramecium aurelia. The species composition was similar at station 2, but new species included Loxocephalus luridus, Stentor coeruleus, and Litonotus lamella. The next two stations, 3 and 4, are characterized by the highest diversity of Ciliata in the given sector of the river. The last two stations, 5 and 6, are characterized by a smaller number of species. On the basis of the differentiation, three zones of river purity were distinguished: a highly polluted zone from Niepolomice to station 3, a zone of transitory character at station 4, and a relatively clean zone at 5 and 6. An atternt has been made to transitory character at station 4, and a relatively clean zone at 5 and 6. An attempt has been made to determine quantitatively the pollution degree based on the indicator values of Ciliata. Differentiation in the species composition of Ciliata was closely correlated with the self-purification process ocurring at the sampling site. (Baker-IVI)
W85-00223 transitory character at station 4, and a relatively

2A. General

APPLICATION OF LANDSAT IMAGERY TO FLOOD STUDIES IN THE REMOTE NA-HANNI KARST, NORTHWEST TERRITORIES, CANADA,

Georgia Univ., Athens. Dept. of Geography.

G. A. Brook.

Journal of Hydrology, Vol. 61, No. 1-3, p 305-324, February, 1983. 5 Fig, 4 Tab, 8 Ref. NASA grant NSG 7539.

Descriptors: *Northwest Territories, *LAND-SAT, *Nahanni karst, *Karst hydrology, Remote sensing, Satellite technology, Infrared imagery, Subarctic zone, Groundwater movement, Hydrology, Snowmelt, Poljes, Flooding, Ponors, Freezing.

LANDSAT imagery has provided important new data about the spectacular hydrology of the Nahanni north karst, one of the most complex subarcic karst landscapes known. Near-infrared band-6 (700-800 nm) and band-7 (800-1100 nm) LAND-SAT images are the most suitable for hydrologic investigations. Images have revealed that prior to spring snowmelt the three poljes and other depressions in the north karst are dry. This suggests that water remaining in depressions in October, when lakes freeze over, drains underground before the following spring. When snow and ice melts in May, several depressions flood because their ponor systems are blocked by ice. Spring snowmelt is not the major hydrologic event of the year; the most intense hydrologic event of the year; the most intense hydrologic activity results from heavy rainthe major hydrologic event of the year; the most intense hydrologic activity results from heavy rainfall in the months June-August. Nahanni depressions flood when there is above-average rainfall in any of these months. In years with no unusually high monthly precipitation, depressions may remain dry or sulfer only minor inundation. Continuation of the LANDSAT program of earth resource data acquisition provides a means of moni-

toring hydrologic conditions in the north karst in the future. (Collier-IVI) W84-00024

KARST HYDROGEOLOGY WITHIN A SU-BARCTIC PEATLAND: ATTAWAPISKAT RIVER, HUDSON BAY LOWLAND, CANADA, Canada Centre for Inland Waters, Burlington (On-

Canada Centre Id.
Lario).
D. W. Cowell.
Journal of Hydrology, Vol. 61, No. 1-3, p 169-175,
February, 1983. 3 Fig. 3 Ref.

Descriptors: *Attawapiskat River, *Ontario, *Geo-hydrology, *Groundwater movement, *Karstifica-tion, *Peatlands, Bogs, Wetlands, Dolines, Inter-mittent lakes, Sinks.

The Attawapiskat River cut through 30 m of mid-Silurian limestone approximately 90 km west of James Bay in the Hudson Bay Lowland. Lime-stone cliffs of 12-15 m provide local relief along the river but inland the terrain is flat, covered by stone cliffs of 12-15 m provide local relief along the river but inland the terrain is flat, covered by 1.5 m or more of peat. The area emerged from the Tyrrell Sea approximately 4400 yr. B.P. Since that time two karst hydrogeological zones have become established: a vadose fluvio-karst zone in the exposed limestone along the river represented by disappearing lakes and streams; and an organokarst zone represented by sinkholes on or next to limestone bioherms within the peat mantle. They occupy 16% and 13% of the study area, respectively. Organo-karst features are expected to expand at the expense of the peatland. Three karst morphologies have evolved. The first morphology occurs where the top of the knoll is higher than the surrounding bog; dolines, often with intermittent ponds or small lakes form at the edge of the reef. The second morphology occurs where the ree fourface is at the same elevation as the surrounding peatland; the bog may encroach onto the reef. The third morphology develops where the reef surface is lower than the surrounding peatland; the bog may drain into the reef. (Collier-IVI)

EVALUATION AND DESIGN OF A STREAM-FLOW-DATA NETWORK FOR CONNECTI-CUT, Geological Survey, Hartford, CT. Water Re-

sources Div.
For primary bibliographic entry see Field 7A.
W85-00052

GEOMORPHIC APPROACH TO HYDROGRAPH SYNTHESIS, WITH POTENTIAL FOR APPLICATION TO UNGAGED WATERSHEDS, isiana State Univ., Baton Rouge. Dept. of Civil

Engineering. V. P. Singh. Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190115, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, June, 1983. 97 p. 27 Fig. 5 Tab, 32 Ref. OWRT Project No. A-058-LA (1), Contract/Grant No. 14-34-0001-2120.

Descriptors: Hydrologic modelling, Stream flow synthesis, Ungaged basins, *Hydrographs, *Un-gaged watersheds, Watersheds.

A conceptual approach, based on the work of Gupta, Waymire and Wang (1980), is developed for synthesis of the instantaneous unit hydrograph (IUH) by employing basin geomorphology. This IUH is then employed in convolution for synthesis of the direct runoff due to a rainfall event. Because the approach contains parameters which can be determined from geomorphology, it is potentially applicable to ungaged basins. A computer model, designated as GMHS, is developed using this approach for hydrograph synthesis. The model is verified on five small agricultural watersheds. The model results compare as well with observations in light of accuracy of the parameters and data. W85-00069

VARIATION OF MODEL PARAMETER VALUES AND SENSITIVITY WITH TYPE OF OBJECTIVE FUNCTION,

Nigeria Univ., Nsukka. Dept. of Geography. F. T. Sefe, and W. C. Boughton. Journal of Hydrology, Vol. 21, No. 2, p 117-132, 1982. 3 Fig. 6 Tab, 16 Ref.

Descriptors: *Optimization, *Model studies, Catchments, Boughton Model, Australia, Sensitivity, Lumped parameter model.

A comparative study was made of ten objective functions used in optimizing an updated version of the Boughton Model (Boughton and Simpson, 1978: An Index Model for Catchment Hydrology. AES Working Paper 1/78, Griffith Univ., Nathan, Queensland) so as to determine how the optimized parameter values varied with type of objective function. Optimum parameter sets obtained for a lumped-parameter model were shown to vary with type of objective function used in the optimization. Moreover, all the parameters need not vary. Owing to interdependence and compensatory nature of the model parameters, only a few parameters need vary to produce a distinct optimum eters need vary to produce a distinct optimum nature of the model parameters, only a few parameters need vary to produce a distinct optimum parameter set. Similarly, parameter sensitivity varied with type of objective function if the parameters were considered individually. When the parameters were considered in groups according to type of objective functions, the variation in sensitivity values proved insignificant. (Baker-IVI) W85-00180

DRAINAGE DENSITY VARIABILITY AND DRAINAGE BASIN OUTPUTS.

Australian National Univ., Canberr Resource and Environmental Studies

D. G. Day. Journal of Hydrology, Vol. 22, No. 1, p 3-17, 1983. 6 Fig, 4 Tab, 33 Ref.

Descriptors: *Drainage basins, *Drainage density, *New South Wales, *Australia, Suspended sediments, Dissolved solids, Rainfall, Rainfall-runoff relationship, Catchment areas, Prediction.

Relationships between the drainage density of channelled flow and stream discharge, suspended sediment, and total dissolved solids were examined during rainfall events for two New England (NSW, Australia) catchments on granite and greywacke. Detailed observations were made on the two catchments. The drainage density of flow was measured as it fluctuated over rainfall events in a 16 month period. Such network changes were related to variability in stream discharge and dissolved solid concentrations for all storms, with higher correlations between these hydrologic variables for individual storms. For the catchments, drainer and the stream of the stream o ables for individual storms. For the catchments, drainage density can be used as a predictor of discharge. Data pooled for each catchment revealed that there are major differences in the runoff response which can be partly attributed to distinctive morphological differences between the catchments, specifically by contrasting densities of channel networks due to basic lithological and pedological differences. Rapid expansion and contraction of the flowing stream network exerts a es for individual storms. For the catchments, traction of the flowing stream network exerts a dominant control on drainage basin outputs. (Baker-IVI)

LUMPED PARAMETER MODEL OF A CHALK AQUIFER-STREAM SYSTEM IN HAMP-SHIRE, UNITED KINGDOM,

Southern Water Authority, Eastleigh (England). T. Keating. Ground Water, Vol. 20, No. 4, p 430-436, July-August, 1982. 4 Fig, 13 Ref.

Descriptors: *Hampshire, *England, *Surface-groundwater relationships, *Chalk aquifers, Math-ematical models, Transmissivity, Storativity, Aquifers, Stream discharge.

The Chalk aquifer in the Candover area of the Hampshire Downs in southern England has a thin, highly transmissive and storative zone in the vicinity of the water table. Attempts to model the aquifer-stream system in the Candover catchment using a conventional two-dimensional mathematical produced with discorts exemptees at each arid intermodel with discrete parameters at each grid inter-

Group 2A-General

section failed because values of storativity in excess of 5% were required to reproduce the observed low groundwater fluctuations while values of 1% were required to simulate stream flows. A lumped parameter model of the aquifer-stream system incorporating a variable transmissivity and storativity distribution has been developed to explain the unusual hydrogeological features of the catchment. The model represents the aquifer as a two-layer system, with the upper layer representing the zone of fluctuation of the water table and consequently having a relatively high storativity (5%) and transmissivity (100,000 sq m/d) and a lower layer representing the main zone of the aquifer with parameters typical of those observed in test pumpings (storativity of 1% and transmissivity of 1,000 sq m/d). The model predicts both observed spring flows and groundwater levels simultaneously, and the decline of computed net gains following the onset of recharge. In practice, the variation of parameters between the upper and lower zones of the aquifer must be continuous. (Moore-IVI) section failed because values of storativity in excess

2B. Precipitation

RESOURCES OF THE TUG HILL REGION State Univ. of New York Coll. of Environmenta Science and Forestry, Syracuse.
For primary bibliographic entry see Field 6D.
W85-00044

PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT CRITERIA FOR SOUTH-EAST ALASKA, National Weather Service, Silver Spring, MD. Office of Hydrology. For primary bibliographic entry see Field 2C. W85-00056

MOVING AVERAGES AND CYCLIC PAT-Oregon State Univ., Corvallis. School of Forestry. R. L. Beschta. R. L. Beschta.

Journal of Hydrology, Vol. 21, No.2, p 148-151, 1982. 3 Fig, 6 Ref.

Descriptors: *Hydrologic models, *Precipitation, *Time series analysis, Correlation analysis, Auto-correlation, Mathematical studies.

An example is provided using annual precipitation data to illustrate how the combination of moving averages and autocorrelation techniques can be used to identify possible periodicities for hydrological time series problems. The annual precipitation averages 1032 mm at the Mt. Torlesse rainfall station with a standard deviation of 175 mm. Coefficients of skewness and kurtosis for annual totals are 0.2 and 2.9 respectively. Represing annual totals ncients of skewness and kurrosss for annual totals are -0.2 and 2.9 respectively. Regressing annual precipitation with time (in years) indicates no long term trend in the data. Thus the time series appears to be stationary and normally distributed. There is a high degree of variability throughout the 73 year record period. Even with the smoothing time series method the occurrence of a definite periodic acries method the occurrence of a definite periodic component remains somewhat obscure. Autocorrelation of the annual precipitation data indicates that little dependency and periodicity apparently exist in this time series and suggests annual precipitation amounts are almost entirely independent from one year to the next. Correlograms developed from the 3, 5, 7, and 9 year moving averages provide a somewhat different result. Several cyclic components are found in the annual precipitation records at the station, with an 18 year cycle being the most pronounced. (Baker-IVI) ced. (Baker-IVI)

IMPACT OF THE DROUGHT IN NATAL KWAZULU, Natal Univ., Pietermaritzburg (South Africa). Inst. of Natural Resources. J. M. Erskine. South African Journal of Science, Vol. 79, No. 11, p 439-440, December, 1983.

Descriptors: *Drought, *Natal, *KwaZulu, *South Africa, Planning, Water resources development,

Groundwater, Seasonal variation, Grazing, Crop

An agricultural drought has two variations. Firstly, a seasonal drought is a regular and predictable event which is limited to a single growing season during which poor rainfall distribution or low total rainfall results in reduced grazing and crop production. Secondly, a disaster drought, in agricultural terms, is a farming situation where, owing to subnormal rainfall, there is a very substantial loss of crops and grazing over one or more growing seasons. While the rainfall over much of Natal/KwaZulu during the 1982-83 normal rainy season seasons. While the rainfall over much of Natal/ KwaZulu during the 1982-83 normal rainy season was more than 35% below the average, and was in itself enough to create a disaster drought situation, the real problem was that this very dry season was preceded by very dry seasons in the three previous years. The coincidental occurrence of both an agricultural drought and a water resources drought had serious repercussions on the people and resources. The consequence this last season was a total failure of all crops in many areas and many total rature of an crops in many areas and many livestock deaths due to poor grazing. The water resources drought has caused many springs and some bore holes that normally provide water right through the dry winter months to dry up due to the drop in the underground water table. It is not possible to predict when good rains can be expected. The planning and preparation for the expected. ed. The planning and preparation for the expected dry season was probably adequate regarding the surface water reserves. Where the inadequacy arose was on the part of the plans for the development of groundwater resources. There has been no coordinated planning of groundwater use in South Africa similar to that carried out in many other parts of the world. (Baker-IVI)

DROUGHT STRESS AND THE DEMISE OF ACACIA ALBIDA ALONG THE LOWER KUISEB RIVER, CENTRAL NAMIB DESERT: PRELIMINARY FINDINGS, Natal Univ., Durban (South Africa). Dept. of

J. D. Ward, and C. M. Breen. South African Journal of Science, Vol. 79, No. 11, p 444-447, December, 1983. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Drought stress, *Kuiseb Ri *Namib Desert, *South-West Africa, *Aci Flooding, Water table, Groundwater recharge.

The Kuiseb River flooded annually past the Namib Desert Research Station at Gobabeb between 1961/62 and 1978/79. Since then, however, it has not flooded into the lower reaches and the Kuiseb not moded into the lower reaches and the Kuiseb water table in the Harubes-Scout River sector has dropped by more than 3 m. During this dry period a considerable number of large mature A. albida trees have collapsed and died. Daily changes in xylem pressure potential of A. albida and A. erioloba, collected near Gobabeb before and after the loba, collected near Gobabeb before and after the 1975-76 Kuiseb flood were investigated. It is probable that the prolonged Juiseb river flood of 1976, together with the unusually heavy rains that summer, had recharged the groundwater reserves in the river bed, at least in the vicinity of Gobabeb. It is also likely that those favorable soil moisture conditions presisted agent another the great heaves. conditions persisted several months after the cessa-tion in April of surface flow in the study site area. tion in April of surface flow in the study site area. Localized stands of juvenile A. albida tress, mainly established after the prolonged flood of 1974 and good rains of 1976 have continued to grow and appear to be fluorishing. It is suggested that the roots of these quick-growing juvenile A. albida trees are able to follow the dropping water table, whereas those of the mature trees are not because of a relatively shallow rooting system established of a relatively shallow rooting system established when the water table was relatively high. (Bakerwher IVI) W85-00215

PRELIMINARY CALCULATIONS OF AVERAGE STORM DURATION AND SEASONAL PRECIPITATION RATES FOR THE NORTH-EAST SECTOR OF THE UNITED STATES, Battelle Pacific Northwest Labs., Richland, WA. J. M. Thorp, and B. C. Scott. Atmospheric Environment, Vol. 16, No. 7, p 1763-1774, 1982. 3 Fig. 9 Tab, 6 Ref. DOE contract DE-AC06-76RLO-1830.

Descriptors: *Precipitation rate, *Storm duration, *Seasonal variation, Storms, Temporal distribution, Rainfall rates.

Regional and seasonal averages of storm duration and precipitation rates are needed as input varia-bles in models aimed at describing precipitation processes relating to acid rain and other problems. Hourly precipitation data for 77 first order weath-Hourly precipitation data for 7/ hrst order weather stations were used to calculate the summer and winter regional average storm duration and average precipitation rates over the northeastern United States. Average storm duration for summer (June-July-August), and winter (December-Janu-ary-February) seasons considered periods of up to three dry hours in summer storms, and up to 6 dry hours in winter storms to be part of the same hours in winter storms to be part of the same storm. Thus, each storm consisted of one or more precipitation periods. The average precipitation event rates for summer and winter storms were event rates for summer and writer storms were calculated. By considering storm durations on an hourly basis, the 3-h summer storm was found to contribute the greatest fraction to total summer precipitation. Similarly, the 26-h winter storm was found to contribute the greatest fraction to winter recepitation. The summer storms triangly contributed tound to constroute the greatest fraction to writer precipitation. The summer storms typically consisted of one rain event lasting about three hours with rain rates averaging about 2.5 mm/h. The 25-h winter storm averaged about 3 precipitation periods (or rain bands). Each period lasted about seven hours and had an average associations of sevent hours and had an average precipitation of rate of 1.0 mm/h. (Author's abstract) W85-00242

DIRECT ACQUISITION OF RAINFALL DATA ON SITE (SAISIE DIRECTE SUR LE SITE DE L'INFORMATION PLUVIOGRAPHIQUE),

Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France). For primary bibliographic entry see Field 7B. W85-00388

DYNAMICS OF INTENSE RAINY SPELLS
OVER THE SOUTH-EAST OF THE MASSIF
CENTRAL - METEOROLOGICAL ASPECTS
AND HYDROLOGICAL APPLICATIONS
(DYNAMIQUE DES EPISODES PLUVIEUX INTENSES SUR LE SUD-EST DU MASSIF CENTRAL; ASPECTS METEOROLOGIQUES ET
APPLICATIONS HYDROLOGIQUES.

Centre National de la Recherche Scientifique, Gre-noble (France). Inst. de Mecanique de Grenoble. P. Tourasse, and Ch. Obled. Houille Blanche, Vol. 36, No. 7/8, p 559-568, 1981. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Masif Central, *France, *Rainfall distribution, Rainfall area, Rainstorms, Floods, Flood flow, Meteorological data collections, Hydrometeorology.

The whole south-eastern side of the Masif Central (in south-east France) is regularly subject, especially in August, to periods of intense rainfall which can cause violent and sometimes catastrophic floods in some basins. Data on all intense rainfall periods (approximately thirty different episodes) from 1970 to 1979 were compiled and analyzed, in hourly steps, using a network of \$8 rainfall recording stations. Systematic plotting of the most interesting episodes revealed that during phases of high activity, rainfall had the very specific shape of a narrow rainy strip a few km wide and parallel to the topographic crest but located 20 km in front of it. The strip contains very intense nuclei within The whole south-eastern side of the Masif Central the topographic crest but located 20 km in front of it. The strip contains very intense nuclei within which rain frequently exceeds 50 mm an hour. These nuclei can cover a few dozen to a few hundred sq km. Joint analysis of hourly rainfall graphs and the concominant meteorological fields has allowed for better understanding of the phenomenon, as well as the relationships which can exist between the main synoptic factors (intensity of flow, position of the front, etc.) and the organization of the rainfall field. The rainfall drip developing over the mountainside did not usually move systematically in a single direction, but the rainfall systematically in a single direction, but the rainfall system, once organized, remained quite stable. Sharp variations in local intensity can be observed, associated with the magnitude of convective activ-

Snow, Ice, and Frost-Group 2C

ity, making the phenomenon one of intermittent character. (Collier-IVI)

PRECIPITATION IN 6 MINUTES, FIRST EX-AMINATION OF SEVERAL MONTHS OF RE-CORDINGS ON MAGNETIC CASSETTES (ES-PRECIPITATIONS EN 6 M'INUTES, PREMIER EXAMEN DE QUELQUES MOIS D'ENREGIS-TREMENT SUR CASSETTE MAGNETIQUE, Electricite de France, Paris. Direction de la Pro-

duction et du Transport.
P. Guillot, and D. Duband. Houille Blanche, Vol. 36, No. 7/8, p 569-576, 1981. 5 Fig. 1 Tab.

Descriptors: *Automation, *France, *Rainfall distribution, Meteorological data collections, On-site data collections, Rainfall intensity, Computers.

The progressive installation of a cassette tape re-corder in the 150 unit EDF network of rainfall corder in the 150 unit EDF network of rainfall recorders solves the problem of recording over a one to two month period in remote places. This also allows for the automation of computerized files on rainfall in six minute time steps. The knowledge of rainfall in such small time units permits: more thorough analysis of the Gradex hypothesis adopted for extreme rainfall conditions over a few hours or for a whole day; analysis of the influence of the chronological irregularity of showers on the instantaneous flow coefficient in the influence of the chronological integration in showers on the instantaneous flow coefficient in the rainfall/flow relation; and measurement quality improvement by allowing for an intensity-linked adjustment to offset the inherent loss of the recorder. The information collected has possible application to the correlation diagram and the calculation of statistical distribution parameters. (Collier-IVI)

CLASSIFICATION OF DAILY, MONTHLY AND SEASONAL RAINFALL OVER FRANCE (TYPOLOGIE DES PRECIPITATIONS QUOTI-DIENNES, MENSUELLES ET SAISONNIERES SUR LA FRANCE),

Meteorologie Nationale, Paris (France).
G. Der Megreditchian, A. De Billy, R. Foka, J. Y. Grosse, and M. C. Rulliere.
Houille Blanche, Vol. 36, No. 7/8, p 589-596, 1981.
5 Fig. 2 Tab, 6 Ref.

Descriptors: *France, *Rainfall distribution, Rainfall intensity, Precipitation rate, Meteorological data collections, Areal precipitation, Climate.

The Water Service of the National Meterological Agency has compiled a record of daily average precipitation by county covering approximately twenty years. A climatic description has been drawn up corresponding to the various scales. This climatic description has been used to produce sets of maps of the traditional parameters of a descriptive statistical analysis and a supplementary study of types of spatial distribution of precipitation. The types of map portraying the spatial distribution of prainfall have been studied over time. Homogeneous climatic zones as regards rainfall (regionalization) were then defined. (Author's abstract)

STATISTICAL REPRESENTATION OF THE ALTERNATION OF DRY AND RAINY SPELLS USING RAINFALL SERIES. APPLICATIONS AT MONTPELLIER-BEL AIR (1920-1971) AND PARIS-MONTSOURIS (1949-1978) (REPRESEN-PARIS-MONISOURIS (1949-1978) (REPRESENTATION STATISTIQUE DES ALTERNANCES PLUIE-NON PLUIE A PARTIR DES SERIES PLUVIOGRAPHIQUES APPLICATIONS A MONTPELLIER-BELL AIR (1920-1971) ET PARIS-MONTSOURIS (1949-1978)), Montpellier-2 Univ. (France) J. M. Masson.

Houille Blanche, Vol. 36, No. 7/8, p 597-604, 1981. 6 Fig. 1 Tab, 6 Ref.

Descriptors: *France, *Montpellier, *Bel Air, *Paris, *Montsouris, *Statistical analysis, *Rainfall distribution, Simulation, Mathematical models, Temporal distribution, Rainstorms.

A succession of showers at individual stations were A succession of snowers at mirrorata standins were portrayed statistically using the shortest possible time interval. Two long rainfall series, Montpellier-Bel Air and Paris-Montsouris, were used. Rainfall series for discrete intervals of one-thousandth of a series for discrete intervals of one-thousandth of a day and a tenth of a millimeter are represented by an alternating series of dry spells (Bs) and rainy spells (Rs), the latter being also characterized by continuous rainfall amount. The marginal distribution of rainfall amount is characterized by a high frequency of measurements lower than, or equal to a threshold (0.4 mm at Montpellier and 0.2 mm at Paris). The frequency distribution of dry spells is bimodal. The first mode corresponds to short dry spells between successive showers, and the second spells between successive showers, and the second to much longer spells of true good weather. Rain-fall amounts have been added over 24 consecutive hours to obtain results similar to a rainfall series in hours to obtain results similar to a rainfall series in which successive rainy days have been accumulated. The observed and the simulated series can then be compared at the level of the first two moments of the variables characterizing a daily rainfall model: length in days of dry and rainy spells and the corresponding amount of the latter. The comparison can also be made using monthly totals. The first simulation shows reasonably satisfactory results, except for the standard deviation of length of dry spells (over-estimated) and heights during rainy spells (under-estimated). (Collier-IVI) W85-00394

2C. Snow, Ice, and Frost

5 Tab, 84 Ref.

NISQUALLY GLACIER, MOUNT RAINIER, WASHINGTON, 1857-1979: A SUMMARY OF THE LONG-TERM OBSERVATIONS AND A COMPREHENSIVE BIBLIOGRAPHY, Geological Survey, Tacoma, WA. C. C. Heliker, A. Johnson, and S. M. Hodge. USGS Open-file Report 83-541, 1984. 20 p, 4 Fig,

Descriptors: Glacier fluctuation, *Nisqually Glacier, *Washington, *Mount Ranier, *Bibliography, *Data collection.

Nisqually Glacier on Mount Ranier, Washington has a long record of terminus position observations and ice-surface altitude measurements along specific profiles, and has been the topic of numerous ic profiles, and has been the topic of numerous scientific studies. From the earliest observations in 1857 to the present many individuals and several different organizations have been involved in data collection at Nisqually Glacier. In order to preserve the long-term data, it was assembled and reduced to a standard format for this report. A comprehensive bibliography of scientific publications relating to the glacier is included. Between 1857 and 1979, Nisqually Glacier receded a total of 1,945 meters and advanced a total of 294 meters. Advances occurred from 1963-68 and from 1974-79. Ice-surface altitude changes of as much as 25 meters occurred between 1944 and 1955. (USGS) W85-00039

PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT CRITERIA FOR SOUTH-EAST ALASKA, National Weather Service, Silver Spring, MD.

National Weather Service, Silver Spring, MD. Office of Hydrology. F. K. Schwartz, and J. F. Miller. Hydrometeorological Report, No. 54, September 1983. 114 p, 43 Fig. 23 Tab, 26 Ref, 1 Append.

Descriptors: *Probable maximum precipitation,
Orographic precipitation, *Snowmelt, *Rain-*Orographic precipitation, *Snowmelt, *Rain-storms, *Thaw, *Precipitation, Stream discharge, Streamflow, Data collection, Hydrologic data col-lection, Dewpoint, *Alaska.

Over a considerable span of time, numerous esti-mates of probable maximum precipitation (PMP) for Alaska have been made for individual basins. for Alaska natve ocen made for individual basins. Generalized all-seasons PMP values were developed, and Spring and early Summer PMP estimates were given. Two factors to be considered were the complicated topography of the region, and the sparsity of daily or hourly precipitation measurements. Data are nearly nonexistent for the

70% of the basins which is above 500 feet. Annual streamflow data were combined with available precipitation data to develop a mean annual precipita-tion (MAP) chart. This along with analysis of small glaciers and snowpack-accumulation season was used as guidance to delineation of generalized was used as guidance to delineation of generalized PMP estimates. An approximation of generalized PMP estimates & An approximation of generalized PMP was developed first from the relations between storm precipitation and PMP in the Northwest States region, and then adjusted by a variety of techniques to provide the basic 24-hour, 10-square-mile PMP map. In general, uniform distribution of PMP is suggested for PMP over basins in Southeast Alaska. However, where fixed significant control of orography exists, it is recommended that the user distribute the PMP in line with such orographic control. A summary of maximum daily rains of record for 49 stations is given, and generalized estimates of snowpack and other snow-melt criteria including temperatures, dew points, and winds is provided. (Garrison-Omniplan)

CHARACTERISTICS OF SNOWFALLS, SNOW METAMORPHISM, AND SNOWPACK STRUC-TURE WITH IMPLICATIONS FOR AVA-LANCHING, CRAIGIEBURN RANGE, NEW ZEALAND.

National Hydrology Research Inst., Ottawa (Ontario).

T. D. Prowse, and I. F. Owens. Arctic and Alpine Research, Vol. 16, No. 1, p 107-118, February, 1984. 6 Fig, 4 Tab, 53 Ref.

Descriptors: *Climates, *Snowfall, *Snowpack, *Craigieburn Range, *New Zealand, *Avalanches, Maritime climates, Temperature gradient, Storms, Snowmelt, Freezing.

Many of the characteristics of snowfall and snow-pack structure in the Craigieburn Range are typi-cal of both maritime and continental climates. While most snowfalls are generally low intensity, small magnitude events as found in continental regions, there is on the average one storm per year which produces snow at such a rate and amount as to pose a direct action avalanche hazard. Strong windspeeds are also a common feature of the area and may create both soft and hard slab avalanches. and may create both soft and hard slab avalanches. While both storm and long term air temperatures are relatively warm, typical of maritime climates, temperature gradient metamorphism, a process commonly associated with but not restricted to cold continental areas, was shown to be prevalent in the basal layers of the snowpack. Ice crusts appear to play an important role in temperature gradient metamorphism and the production of depth hoar crystals. Equitemperature metamorphism is the dominant process in the Craigieburn anowpack but temperature gradient and melt phism is the dominant process in the Craigieburn snowpack but temperature gradient and melt freeze metamorphism are also important, the latter resulting from mid-winter rain and melt events. In general, maritime climates are characterized by direct action avalanching resulting from large inputs of snow while in continental climates, where snowfalls are relatively small, structural weaknesses create a considerable potential for climax avalanching. The findings of this study are particular to the primarily leeward locations of the Craigieburn Range. Because of the strong regional variations in alpine climate, which although not accurately quantified, are known to exist in New Zealand, any inter-regional extrapolation of these reland, any inter-regional extrapolation of these results must be conducted extremely circumspectly. (Baker-IVI) W85-00113

INFLUENCE OF NON-UNIFORM TEMPERA-TURE DISTRIBUTION ON THE STEADY MOTION OF ICE SHEETS,

University of East Anglia, Norwich (England). School of Mathematics and Physics.

L. W. Morland, and G. D. Smith. Journal of Fluid Mechanics, Vol. 140, p 113-133, March, 1984. 7 Fig, 1 Tab, 14 Ref. NERC grant GR3/4114

Descriptors: *Ice sheets, *Glaciers, *Temperature gradient, Ice properties, Ablation, Ice temperature,

Field 2—WATER CYCLE

Group 2C-Snow, Ice, and Frost

Plane steady flow, Viscous rate factor, Mathemati-

cas equations.

Large ice sheets have significant temperature variation with depth, with melting or near-melting temperatures in some basal regions to colder temperature at the surface but more modest temperature gradients over their much greater spans. The plane steady flow of a grounded ice sheet is analyzed under the assumption that the ice behaves as a nonlinearly viscous fluid with a strongly temperature-dependent rate factor. The accumulation/ablation distribution on the (unknown) free surface is prescribed, and there is a given basal sliding condition connecting the tangential velocity, tangential traction and normal pressure. The basal boundary is the smooth contour which describes the mean topography viewed on the ice-sheet lengthscale, and is assumed to have small slope. Perturbation analysis is extended to the non-isothermal problem when the temperature distribution is prescribed. The thermomechanically coupled energy balance when the temperature distribution is prescribed. The thermomechanically coupled energy balance is not solved, but families of temperature distributions qualitatively compatible with observed patterns are adopted to exhibit the effects of significant creep-rate variation with temperature. There is no optimum mean temperature for which the isothermal solution approximates satisfactorily to solutions for even simple temperature patterns varying only with depth. (Collier-IVI) W85-00173

ENERGY BALANCE OVER MELTING SNOW, CRAIGIEBURN RANGE, NEW ZEALAND, National Hydrology Research Inst., Ottawa (On-

T. D. Prowse, and I. F. Owens. Journal of Hydrology, Vol. 21, No. 2, p 133-147, 1982. 5 Fig, 5 Tab, 44 Ref.

Descriptors: *Energy balance, *Snowmelt, *New Zealand, *Craigieburn Range, Heat flow, Net radiation, Humidity, Wind, Rainfall.

ation, Humidity, Wind, Rainfall.

The energy balance method was applied to periods of spring snowmelt in the Craigieburn Range, New Zealand to assess the relative importance of the individual heat flow components during both long-term and intense periods of seasonal snowmelt. During spring snowmelt, sensible heat is the major source of energy to the snowpack, contributing approximately sixty percent of the total heat supply. Above average air temperatures and wind-speeds, typical of northwesterly airstreams, are primarily responsible for the dominating influence of the sensible heat flux. Over the long term, daily inputs of sensible heat under such north-westerly conditions are similar in magnitude to those reported for chinooks in Canada. Net radiation is the second most important heat flux, reaching maximum levels during calm, clear periods late in spring. Under heavy cloud, high humidity and strong wind, radiation heat flow is less than latent heat flow. The greatest total heat flux to the snow-pack occurs on days with rain, although the precipitation heat flow is relatively unimportant, less than eight percent of the total heat supply. Sensible and latent heat are the most important heat supply during rain. Future studies of snowmelt should concentrate upon obtaining more data on the size and relative importance of heat flows during sneconcentrate upon obtaining more data or the size and relative importance of heat flows during spe-cific weather systems and especially during wet north-westerly airflows. (Baker-IVI) W85.00181

EFFECTS OF INCREASING SNOWPACK ON A SUBALPINE MEADOW IN THE UINTA MOUNTAINS, UTAH, U.S.A., Native Plants, Inc., Salt Lake City, UT. W. K. Ostler, K. T. Harper, K. B. McKnight, and D. C. Anderson.

Arctic and Alpine Research, Vol. 14, No. 3, p 203-214, August, 1982. 4 Fig. 8 Tab, 28 Ref. Water and Power Resources Service contract 6-07-DR-20060.

Descriptors: *Snowpack, *Subalpine zone, *Uinta Mountains, *Utah, *Meadows, Cloud seeding, Weather modification, Environmental effects, Vegetation, Soil depth, Water stress, Plant cover.

The Uinta Mountains of Utah are a target area for possible winter cloud seeding for the augmentation

of precipitation. Sampling sites were established along naturally occurring snowdrifts in order to assess the long-term impacts of increased snow-pack on a subalpine meadow. The area was divided into three zones (light, moderate, and heavy snow-pack) based on snow depths measured on 1 April. Sites were sampled from 1976 through 1979. Slope, exposure, soil texture, and pH did not differ significantly between snowpack zones in the study area. The variables sampled which decrease with increasing snowpack are soil depth. organic matter. The variables sampled which decrease with increasing snowpack are soil depth, organic matter, plant moisture stress, total plant cover, and plant production. Snow release date, number of species per macroplot, exposed rock, and total flowering period increase with increasing depth of the snowpack. A relative decline in plant cover and plant production is predicted for additional increases in snowpack. Individual plant species responses show that 14 species achieve maximum cover in the heavy snowpack zone while only six reach maximum cover in the light snowpack zone. Ten species show no preference for snowpack zones. Production data for the 4 yr of study show considerable variation between years. Differences in the able variation between years. Differences in the yearly production figures are primarily due to the response of the graminoids which increase with increased growing season precipitation and decrease with greater snowpack. Forb production did not change significantly among the 4 yr of study. (Moore-IVI)

W85-00236

BASAL ICE IN HIGH ARCTIC SNOWPACKS, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography. M.-K. Woo, R. Heron, and P. Marsh. Arctic and Alpine Research, Vol. 14, No. 3, p 251-260, August, 1982. 10 Fig, 16 Ref.

Descriptors: *Basal ice, *Arctic, *Snowpack, *Snowmelt, Sublimation, Ice erosion, Melting, Freezing, Sediment transport, Channel erosion, Ice breakup, Runoff.

breakup, Runoff.

In late May or June, meltwater percolating through cold arctic snowpacks often refreezes as ice layers. In the presence of a cold substrate, such layers form at the base of the snowpack. This basal ice continues to grow so long as meltwater supply is sustained and the substrate remains below 0 degrees C. Upon exposure, the ice is destroyed by sublimation and surface melting or by thermal and mechanical erosion by water which runs on, in or under the ice. Multiyear ice is preserved when the incompletely melted basal ice is buried by subsequent snowfall or by a layer of earth materials. Multiple freezing and melting of water in basal ice layers complicate the snowmelt-runoff relationship in three principal ways. Where basal ice is abundant, the melt is prolonged and contributes to streamflow during the drier summer months. During breakup, the basal ice in stream beds tends to increase flow velocity and, consequently, the capacity for sediment transport. However, a basal ice layer in the channel will reduce opportunities for erosion. (Author's abstract)

2D. Evaporation and Transpiration

TEMPERATURE AND EVAPOTRANSPIRA-TION GRADIENTS OF THE WHITE MOUN-TAINS, NEW HAMPSHIRE, U.S.A., Dartmouth Coll., Hanover, NH. Dept. of Bologi-

Dathount conf., Handver, NH. Dept. of Bological Sciences.
W. A. Reiners, D. Y. Hollinger, and G. E. Lang.
Arctic and Alpine Research, Vol. 16, No. 1, p 3136, February, 1984. 2 Fig. 2 Tab, 27 Ref.

Descriptors: *Evapotranspiration, *Temperature gradient, *White Mountains, *New Hampshire, Air temperature, Soil water, Forests, Canopy, Mountains, Degree days.

Air temperatures and soil moisture percentages were measured below forest canopies along an environmental gradient in the White Mountains of New Hampshire. The following gradients of decline with altitude were estimated from these data: within forest air temperature, growing degree

days, and potential and actual evapotranspiration. These gradients provide a basis for the develop-These gradients provide a basis for the develop-ment of predictors for rates of ecologically signifi-cant phenomena such as water balance, net pri-mary production, and decomposition rates. Such mary production, and decomposition rates. Such data are important for the development of predictive models for several ecological processes the most obvious being the annual hydrological water balance of mountain watersheds. Degree days is a very useful parameter for estimating metabolic rates and distributional limits of pollutants. Actual evapotranspiration is useful for estimating primary productivity of mature ecosystems, detrital decomposition rates, and litter decomposition. (Baker-IVI) W85-00111

INTERCEPTION OF PRECIPITATION BY FOREST PLANTATIONS (L'INTERCEPTION DES PRECIPITATIONS PAR LES PEUPLE-MENTS FORESTIERS)

Centre National de Recherches Forestieres, Seichamps (France). Station de Sylviculture et de Production. G. Aussenac.

Houille Blanche, Vol. 36, No. 7/8, p 531-536, 1981. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Interception loss, *Forest hydrology, *Evapotranspiration, Transpiration, Evaporation, Meadows, Rainfall intensity, Trees.

Interception is substantial in forest plantations; it represents 25 to 45% of annual precipitation for resinous trees and 15 to 30% for leafy varieties. Interception varies with the characteristics of the tree population (density, age). It also depends on rain intensity, its permanent or intermittent character, and the evaporating capacity of the air. Most of the water intercepted evaporates. Evaporation is two or three times faster than the speed at which transpiration occurs. As a result, the tree loses 80 transpiration occurs. As a result, the tree loses so to 85% of the intercepted water, with no offsetting compensation. According to the frequency of rainy spells, the real and potential evapo-transpiration of the forest population will be higher or lower than the potential evapo-transpiration of meadows. (Au-'s abstract) W85-00390

2E. Streamflow and Runoff

EFFECTS OF GLACIATIONS UPON KARST AQUIFERS IN CANADA,

McMaster Univ., Hamilton (Ontario). Dept. of Ge-

Journal of Hydrology, Vol. 61, No. 1-3, p 149-158, February, 1983. 1 Fig. 2 Tab, 21 Ref.

Descriptors: *Karst hydrology, *Glaciation, *Canada, Limestone, Glacial drift, Aquifers, Carbonates, Rocky Mountains.

In Canada there are 570,000 sq km of limestone and marble outcrop, 600,000 sq km of dolomite and 80,000 sq km of sulfate rocks. In addition, halite subcrops beneath 500,000 sq km of the central Prairie region and interacts with modern ground-Prairie region and interacts with modern ground-water circulation to a varying extent. More than 90% of the total outcrop-subcrop has been repeat-edly glaciated. The most recent time terminated 13,000-5000 yr B.P. in certain areas. Carbonate terrains still partly buried by glacier ice may be inspected in the Rocky Mountains. Nine distinct effects of glacial action on the propagation and efficiency of karst aquifers are recognized. De-structive effects include erasure, dissection, infili-ing and injection. Bedrock solution may be inhibit-ed during non-glacial periods by a cover of glacial ed during non-glacial periods by a cover of glacial drift rich in carbonate clasts. Glacial burial may and then in caroonate class. Glacial burial may also preserve an aquifer and enhance its storage characteristics. Raising the hydrostatic head or steepening hydraulic gradients may stimulate aqui-fer expansion. (Baker-IVI) W85-0009

Groundwater-Group 2F

RESPONSE OF FISHES TO PERIODIC SPRING FLOODS IN A SOUTHEASTERN STREAM,

University of Southern Mississippi, Hattiesburg. Dept. of Biology. For primary bibliographic entry see Field 2H. W85-00130

RESPONSE OF BRAIDED RIVERS TO CHANGING DISCHARGE, Ministry of Works and Development, Christ-church (New Zealand).Water and Soil Science

M. P. Mosley.

Journal of Hydrology, Vol. 22, No. 1, p 18-67, 1983. 26 Fig, 4 Tab, 27 Ref.

Descriptors: *Braided streams, *Discharge measurement, *Ashley River, *Hurunui River, *Rakaia River, *Ahuriri River, *New Zealand, Flow discharge, Water surface area, Riffles, Pools, Runs, Channels.

Data to describe the physical characteristics of selected reaches were collected on the Ashley, Hurunui, Rakaia and Ahuriri Rivers to search for Hurunui, Rakaia and Ahuriri Rivers to search for the existence of common relationships between the braided river environment and discharge. Water surface width, mean and maximum depth, mean and maximum velocity and cross sectional area of transects across individual branch channels and of cross sections across all channels increased with discharge. Simple power functions fitted to these relationships are similar to those of braided changles flowing over noncohesity bed material. Changles flowing over noncohesity bed material. discharge. Simple power tuneators the relationships are similar to those of braided channels flowing over non-cohesive bed material. Cumulative plots of depth and velocity demonstrate regularities in the form of the study rivers. No significant relationships were found between discharge and the number of branch channels and the proportion of flow in each. The areas of riffle, pool and run subenvironment all increase with increasing discharge. Water surface area in pools in creases more slowly than does total water surface area, in riffles more rapidly, and in runs at approximations of the proposition of the properties of the propertie creases more stowly man does total water surface area, in rifles more rapidly, and in runs at approxi-mately the same rate. Hence the relative propor-tions of these subenvironments change with dis-charge. The areas of smooth, wavy and broken water expand as discharge increases but at differ-ent rates. Bed sediment size distributions in a given ent rates. Bed sediment size distributions in a given channel do not appear to change as discharge and lateral channel extent increase, until discharge increases to a point where sediment movement occurs, caused for example by the introduction of fine sediment from upstream. Although general qualitative relationships exist between discharge and channel characteristics, variability is so great that the relationships have little predictive value. Changing discharge is only one source of variation in channel characteristics. Other sources include differences between rivers, between reaches, between cross-sections, between branch channels, between cross-sections, between branch channels, bedifferences between rivers, between reaches, between cross-sections, between branch channels, between transects on a given branch channel, and due to the effect of floods. The effect of changing discharge is no greater than any one of these taken individually, and their aggregated effects mask the effects of changing discharge. (Baker-IVI) W85-00184

STORMFLOW GENERATION IN A HEADWA-TER BASIN IN THE TAMA HILLS (IN JAPA-

NESE), Tsukuba Univ. (Japan). Inst. of Geoscience. M. Yasuhara, S. Takayama, and Y. Suzuki. Japanese Journal of Limnology, Vol. 45, No. 1, p 44-50, January 1984. 11 Fig, 12 Ref.

Descriptors: *Headwaters, *Storm runoff, *Tama Hills, *Japan, Rainstorms, Storm seepage, Subsur-face water, A-horizon.

Research was conducted in a small headwater basin of 0.56 ha in size in the Tama Hills to clarify the mechanism of stormflow generation. Observations were made in the field during and after a 130.5 mm rainstorm occurred on Oct. 7-8, 1979. At 130.3 mm rainstorm occurred on Oct. 1-8, 1979. At each stage of the rainstorm the relationship between subsurface water behavior and stormflow generation was established by using 56 observation wells and 40 tensiometers. Three contributors to stormflow generation were recognized: subsurface stormflow in the A-horizon, saturation overland

flow, and flow from the shallow groundwater body. A quantitative analysis of the observed results revealed that the subsurface stormflow in the A-horizon was the most important contributor to stormflow generation in the experimental basin. In regions such as Japan where rainstorms with a total rainfall of more than 100 mm often occur, much more attention should be concentrated on the role of the A-horizon in stormflow generation.

DETERMINATION OF THE HYDRAULIC ROUGHNESS OF A VEGETATED FLOOD-PLAIN, Yu. N. Sokolov

Hydrotechnical Construction, Vol. 16, No. 2, p 96-100, February, 1982. 2 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 2, p 33-36, February, 1982.

Descriptors: *Flood plains, *Hydraulic roughness, *Vegetation, Design criteria, Hydraulic engineer-

The designing of hydraulic structures on rivers with floodplains is associated with a determination of the water conveying capacity of the floodplains. To determine the capacity of a floodplain requires not simply a representative depiction of the floodplain relief, but understanding its characterization so that it would be correlated with the velocity regime of the flow measured at the stream-gauging station. The next step after determining the statistical parameters of the floodplain relief is the establishment of the relation between these parameters lishment of the relation between these parameters and the coefficient describing the roughness of the floodplain stretches. The hydrometric data obtained in field studies are used in this study. The tained in field studies are used in this study. The method proposed for characterizing the roughness of the relief and vegetation permits, without con-ducting costly hydrometric works in the flood period, a differentiated estimation of the change in the roughness coefficient of a floodplain in time and space on the basis of serial photogrammetric or ground topographic and geobotanic surveys in the low water period. (Baker-IVI) W85-00437

SOME ASPECTS OF PRACTICAL CALCULATIONS OF UNSTEADY FLOW IN OPEN CHANNELS.

Hydrotechnical Construction, Vol. 16, No. 4, p 220-225, April, 1982. 14 Ref. Translated from Gi-drotekhnichenkoe Stroitel'stvo, No. 4, p 25-28,

Descriptors: *Unsteady flow, *Water resources management, *Open channels, Mathematical equations, Flow, Lakes, Reservoirs, Overland runoff.

In calculations of unsteady flow in natural bodi of water one must deal with situations where the one-dimensional model is insufficient and it is necessary to to solve the two-dimensional problem. essary to to solve the two-dimensional problem. Calculations of unsteady flow play an important part in the case of water resources management. Such aspects as direct coordination with water management calculations, operative planning and management in the automated control system of river basins, and the hydraulic calculation of interbasin water transfer routes are areas of interest. Use of the calculation of unsteady flow in the case ose of the calculation of traditional hydrological investigations is also described. Practical aspects of calculating unsteady flow in rivers are noted briefly. (Baker-IVI)

REFLECTION OF A SURGE FROM A VERTI-

CAL WALL, A. V. Mishuev, and M. S. Sladkevich. Hydrotechnical Construction, Vol. 16, No. 4, p 225-228, April, 1982. 4 Fig. 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 28-30, April, 1982.

Descriptors: *Surges, *Hydraulic structures, Vertical distribution, Rivers, Flow, Channels, Reser-

Cases of the interaction of a surge with a vertical wall are possible in the operation of hydraulic structures. Such a situation can occur when a surge propagating along the channel of a river, canal, or propagating along the channel of a river, canal, or a reservoir encounters a hydraulic structure. When investigating the force of the surge on structures and problems of flooding of a territory it is important to have a correct determination of the parameters of the reflected wave. When the surge approaches the wall an impact lasting several fractions of a second occurs at the instant of first contact. The wall is passed around by the flow, which can be considered quasisteady and equations of hydraulics describing steady flows can be used. Measurements of the reflection of a surge from a vertical wall were taken by motion picture filming and wire type wave recorders operating on the vertical wall were taken by motion picture liming and wire type wave recorders operating on the principle of measuring the resistance between wires which changes depending on the depth of water. The theoretically obtained relations of the depths in the reflected wave with consideration of overflow for all values of the relative wall height overtiow for all values of the relative wall height satisfactority agree with the experimental data and also with data obtained in a study of the uprush of a solitary wave on a vertical wall. These findings can be used in preliminary estimations of flood zones and forces in the case of uprush of long wave on hydraulic structures. (Baker-IVI) W85-00454

CONSTRUCTION OF THE FLOOD (FRESHET) HYDROGRAPH OF A GIVEN PROBABILITY WITH CONSIDERATION OF ITS UNFAVOR-ABLE SHAPE

N. S. Kashinov Hydrotechnical Construction, Vol. 17, No. 9, p 429-439, September, 1983. 8 Fig. 4 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 8-15, September, 1983.

Descriptors: *Flood hydrographs, *Freshet, *Probabilities, Storage reservoir, Reservoirs, Runoff, Powerplants, Prism storage.

The main purpose of flood (freshet) hydrographs is to determine the most rational combination of the to determine the most rational combination of the discharge capacity and prism storage of a reservoir for storing the runoff in the period when the inflow to the reservoir exceeds the discharge capacity of the hydrostation. A method is presented for constructing the design hydrograph taking into account for the first time the probability of the distribution of the high runoff between the rising and falling limbs (rise and recession, respectively) distribution of the high runoff between the rising and falling limbs (rise and recession, respectively) during storage. The design hydrograph with given probabilities of maximum runoff and its distribution relative to the maximum after introducing the correction factors is exhibited. (Baker-IVI) W85-00489

2F. Groundwater

POINT-RECHARGE OF LIMESTONE AQUIFERS - A MODEL FROM NEW ZEA-LAND KARST, Manchester Polytechnic (England). Dept. of Envi-ronmental and Geographical Studies.

Journal of Hydrology, Vol. 61, No. 1-3, p 19-29, February, 1983. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Karst hydrology, *Groundwater re-charge, *New Zealand, Model studies, Sinkholes, Pits, Limestone, Aquifer recharge, Hydrologic models.

Closed depressions of moderate dimensions (solution dolines, sinkholes, cockpits) are a widely described feature of limestone terrains, but very little attention has been paid to their contemporary hydrological function. The mechanisms by which depressions concentrate near-surface waters and transmit them to underlying against has been in depressions concentrate near-surface waters and transmit them to underlying aquifers has been investigated through the use of a depression hydrology model. The area of study was located 7 km west of the Waitomo Caves in the King Country of west-central North Island. The karst is developed on the Oligocene Te Kuiti Group of limestones, the most widely outcropping carbonate rocks in New Zealand. Water transmitted by each flow

Group 2F—Groundwater

mechanism in the depression hydrology model was sampled to test the hypothesis that their existence may be justified by the differences in their chemical and physical characteristics. Overland flow occurs infrequently following intense and/or prolonged rainfall and it is regarded as relatively be unimportant. Throughflow may tentatively be divided into two sub-components: flow in the upper soil horizons which responds rapidly to rainfall; and slower sustained flow. Subcutaneous flow shows a rapid increase in discharge following storm rainfall, due to the transmission of infiltrating pulse waves, but storm water has a flowing pulse waves, but storm water has a flow-through time of 2-10 weeks. Shaft flow is chemithrough time of 2-10 weeks. Shaft flow is chemically indistinguishable from subcutaneous flow but has a greater annual temperature range. Two subsets of vadose flows were identified: flows which travel through open joints and fissures to the underlying conduit; and flows which travel through soil-filled fissures. Vadose seeps in the four study caves have similar solute concentrations and their mean calcium ion concentrations are significantly leaves that there of the other temperatures. lower than those of the other transmission mechanisms and those of subcutaneous flows. (Baker-IVI) W85-00002

LINEAR UNIT-RESPONSE FUNCTIONS AS INDICATORS OF RECHARGE AREAS FOR LARGE KARST SPRINGS, California Univ., Santa Cruz. Dept. of Earth Sci-

S. J. Dreiss. S. J. Dreiss. Journal of Hydrology, Vol. 61, No. 3, p 31-44, February, 1983. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Precipitation, *Karst hydrology, *Groundwater recharge, Springs, Aquifer recharge, Groundwater recharge, Surface-groundrelations. Precipitation

Linear kernel functions derived from the spring-flow response of large karst springs to intense, isolated storms are most physically realistic and have the greatest predictive accuracy when the assumed spring recharge area is consistent with tracer study results. This observation implies that, if sufficient precipitation spring discharge data are available, such derived kernel functions could be available, such derived kernel functions could be useful for identifying or validating assumed spring recharge areas. For example, in the absence of detailed tracing data a researcher might propose a number of feasible recharge areas for a spring and derive kernel functions, using the average precipi-tation for each of these proposed areas. The shape and predictive accuracy of the derived kernels would reflect the accuracy of the location of the assumed recharge areas. The effectiveness of these kernel function properties in delineating recharge. assumed rectange areas. In electroverses of mease kernel function properties in delineating recharge boundaries would depend on the size of the spring relative to the areal extent of the monitor storm, the homogeneity of soil and vegetation conditions, and the areal distribution of the precipitation sta-tions. (Baker-IVI) W85-00003

ROLE OF THE SUBCUTANEOUS ZONE IN KARST HYDROLOGY, Auckland Univ. (New Zealand). Dept. of Geogra-

Journal of Hydrology, Vol. 61, No. 1-3, p 45-67, February, 1983. 11 Fig. 52 Ref.

Descriptors: *Karst hydrology, Groundwater, Subcutaneous zone, Saturation zone, Vadose water, Permeability, Chemical reactions.

The subcutaneous zone is the upper weathered layer of rock beneath the soil, but above the permanently saturated (phreatic) zone. It is of particumanenty saturated (phreatic) zone. It is of particu-lar hydrological importance in karst because of its high secondary permeability, arising from the con-siderable chemical solution in this zone. The im-portance of subcutaneous storage in sustaining ba-seflow discharge at some sites must be recognized, as must the contribution of subsurbances. as must the contribution of subcutaneous water to flood hydrographs. Methods of estimating the volumes of subcutaneous and phreatic components of karst spring flood hydrographs are presented. A discussion is included of the significance of subcutaneous hydrologic processes for an understanding of karst geomorphology. The desirability of explaining karst landform evolution in terms of hydrologic processes is stressed. (Baker-IVI) W85-0004

KARST LANDFORMS AND DRAINAGE BASIN EVOLUTION IN THE OBEY RIVER BASIN, NORTH-CENTRAL TENNESSEE, U.S.A., Pennsylvania State Univ., University Park. Dept.

of Civil Engineering.

E. L. White, and W. B. White.

Journal of Hydrology, Vol. 61, No. 1-3, p 69-82,

February, 1983. 7 Fig. 1 Tab, 14 Ref.

Descriptors: *Karst hydrology, *Obey River Basin, *Tennessee, Cumberland Plateau, Lime-stone, Permeability, Warsaw Formation, Wolf River, Obey River, Roaring River, Subsurface

An extensive karst landscape is developed on the Mississippian limestones of the dissected western margin of the Cumberland Plateau. The internal margin of the Cumberland Plateau. The internal drainage from the dolines and from the sinking streams is perched on the impermeable Warsaw Formation and emerges as contact springs on the inner gorges of the rivers which have cut deep narrow valleys below the level of the upland sur-face. Tributary streams to the Wolf, Obey and Roaring rivers (tributaries of the Cumberland River in north-central Tennessee) were analyzed Roaming rivers (tributaries of the Cumeriand River in north-central Tennessee) were analyzed by fitting their longitudinal profiles to exponential and logarithmic functions. Linear segments of semilogarithmic plots permitted extrapolating both active streams and under drained stream channels through the doline karst. Active stream systems maintain, on the average, the profiles and gradients that they would have had if they had been flowing that they would have had if they had been flowing in normal surface channels. Streams emerge from the karst at elevations appropriate to the hydraulic characteristics of the drainage basin that fed the system. The dry under drained channels in fluviokarst can be related to river terraces and erosion surfaces in the same way that dry upper level cave passages can be so related. The tributary stream channels examined here relate the Highland Rim surface, the band of doline karst that borders th surface, the band of doline karst that borders the Cumberland Escarpment, and the flood plains of the principal rivers. The maintenance of the hy-draulic profile of the tributary streams through their under drained reaches suggests that the de-velopment of subsurface drainage and the excava-tion of conduits by dissolution of the limestone is a more rapid process than is the adjustment of the surface channels. The sub-surface conduit systems are to keep nace with the surface channel with. seem to keep pace with the surface channel with-out difficulty. (Baker-IVI) W85-00005

HYDROLOGY AND HYDROCHEMISTRY OF THE CAVES BRANCH KARST, BELIZE, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography. T. Miller.

Journal of Hydrology, Vol. 61, No. 1-3, p 83-88, February, 1983. 2 Fig. 7 Ref.

Descriptors: *Aquifers, *Karst hydrology, *Water storage, Chemical reactions, Calcium carbonate, Belize, Central America, Solute transport, Caves.

A large conduit spring issuing from Cretaceous limestones in Belize, Central America, displays a positive relation of discharge to solute concentra-tion. Beneath a maturely dissected cockpit karst, the hydrologic system combines allogenic surface water from an invasion polje with authigenic karst water. Dynamic mixing produces three climatical-ly induced discharge phases: baseflow, normal, and high stage flow. Comparisons of aquifer storage with the total amount of discharge recorded during the summer showed the latter was insufficient to entirely replace the storage and that the mean residence time was on the order of several months, even during the wet season. Zuhuyhas were only the visible part of extensive networks within the karst that collect diffuse flows into conduit-type passages. Runoff enters the karst through many openings, rapidly passes to the phreatic zone, then percolates slowly for several months, achieving high saturation before resur-gence at many discrete resurgences. The influx of high hardness karst aquifer water into the trunk channel can be considered a type of flushing event, then, but on a much grander scale than that then, but on a much grander scale than that common nearly everywhere else. The mean total hardness of hundreds of samples collected from diffuse springs indicates of samples collected from diffuse springs indicates higher concentrations than expected. Discharge weighted total hardness was about 215 mg/l calcium carbonate, giving a denu-dation rate of about 100 mm per 1000 yr. (Baker-W85-00006

HYDROSTRATIGRAPHIC SUBDIVISIONS AND FAULT BARRIERS OF THE EDWARDS AQUIFER, SOUTH-CENTRAL TEXAS, U.S.A.,

Geological Survey, San Antonio, TX. R. W. Maclay, and T. A. Small. Journal of Hydrology, Vol. 61, No. 1-3, p 127-146, February, 1983. 11 Fig. 1 Tab, 9 Ref.

Descriptors: *Karst hydrology, *Geologic fractures, *Texas, *Edwards Aquifer, Aquifers, Groundwater, Stratigraphy.

The karstic Edwards Limestone within the Balcones Fault Zone of south-central Texas forms a productive confined aquifer that consists predominantly of dense carbonate rocks and contains several layers of highly permeable and porous honeycombed rocks that have been produced by the leaching of evaporitic, tidal flat or reefal deposits. The Edwards aquifer not only supplies the water requirements for a population of more than one million people, but it also supplies the water needed for extensive irrigation. Fractures have hydraulically interconnected these layers at some needed for extensive irrigation. Fractures have hydraulically interconnected these layers at some places. Faults, however, commonly place rocks of very high permeability opposite rocks of very low permeability, thus creating a lateral discontinuity and a flow barrier. At places, fault barriers probably cause partial to almost complete blockage of groundwater flow normal to the fault. This kind of discontinuity is very component in the acusters and discontinuity is very common in the aquifer, and it may exert a major control on the direction of groundwater flow within it. (Baker-IVI)

UPPER SALMON RIVER KARST, ANTICOSTI ISLAND, QUEBEC, CANADA, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography.
J. Roberge, and D. C. Ford.

Journal of Hydrology, Vol. 61, No. 1-3, p 159-162, February, 1983. 1 Fig. 3 Ref.

Descriptors: *Karst hydrology, *Anticosti Island, *Quebec, Carbonates, Glacial sediments, Groundwater. Groundwater movement.

Anticosti Island is composed of medium- to thin-bedded carbonates of low dip and low relief. The island was glaciated during the Late Wisconsin but isiand was ginerated during the Late wisconsin out drift cover is thin because of marine overwash. The principal karst extends along the joint set with 38 sq km holokarst area and 105 sq km allogenic catchment. No evidence for karst features older catchment. No evidence for karst features older than the postglacial period was found in this area, or of glacial interference with the groundwater circulation system. The system and landforms are most probably of postglacial age. (Baker-IVI) W85-00010

KARST HYDROLOGY OF THE BRUCE PE-NINSULA, ONTARIO, CANADA, Canada Centre for Inland Waters, Burlington (On-

D. W. Cowell, and D. C. Ford. Journal of Hydrology, Vol. 61, No. 1-3, p 163-168, February, 1983. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Karst hydrology, *Drainage, *Bruce Peninsula, *Ontario, Niagara Escarpment, Scour-ing, Groundwater movement, Sinkholes.

The Niagara Escarpment forms the eastern boundary of the deeply scoured dolomite plain of the Bruce Peninsula. The Bruce Peninsula represents

Groundwater-Group 2F

an early karstification of a cuesta-bounded dolomite plain. Normal surficial channel drainage on the backslope competes with groundwater drainage to the scarp foot. This results in the progressive karstification of the carbonate mass. Nearest the scarp is a zone of holokarst dominated by vertical drainage and lacking normal surface chancels. Westward of this zone are at least five small fluvio-karst basins which have regular surface flow but are drained entirely by sinkholes. Most of the remaining drainage is normal surface flow draining westward away from the escarpment. Three drainage conditions found on the Bruce Peninsula are described. (Baker-IVI)

KARSTIC INTERPRETATION OF THE WINNI-PEG AQUIFER (MANITOBA, CANADA), McMaster Univ., Hamilton (Ontario). Dept. of Ge-

Journal of Hydrology, Vol. 61, No. 1-3, p 177-180, February, 1983. 1 Fig. 4 Ref.

Descriptors: *Aquifers, *Winnipeg, *Manitoba, *Transmissibility, *Permeability, *Karst hydrology, Carbonate aquifers, Sandstone aquifers, Groundwater pollution, Wells, Water pollution sources, Glacial tills.

At Winnipeg, the Upper Carbonate Aquifer lies 10 to 15 m below an erosion surface that bevels dolomites, limestones, and minor shales. The aquifer extends over more than 3400 sq km and is confined by overlying glacial tills and lake clays. This preglacial limestone pavement karst was preserved intact because glacial ice was frozen at the base and could neither scour nor infill it. Karst aquifer capability was greatly enhanced by glacial action. The Upper Carbonate Aquifer displays high storage and transmissibility: transmissibility ranges from 25 to 2500 cu m/day. Two hundred commercial and industrial wells and thousands of commercial wells have been drilled in this aquifer over a period of at least 130 years. Overlying lake clays function as an aquiclude, shielding the aquifer from pollution by surficial sources. A 20 to 22 m thick Lower Carbonate Aquifer is confined to basal dolomitic limestones: transmissibility nowhere exceeds 60 cu m per day. Two underlying basal dolomitic limestones: transmissibility no-where exceeds 60 cu m per day. Two underlying sandstone aquifers are confined by shales at the base of the sedimentary rock section: they contain highly saline water (TDS = 30,000 to 80,000 mg/ I). The Upper Carbonate aquifier is probably not being expanded by further solution. High dissolved solids recorded in the aquifer are attributed to contamination from wells drilled into the sandstone equifers (Collies IVI). aquifers. (Collier-IVI) W85-00013

GOOSE ARM KARST, NEWFOUNDLAND, CANADA.

McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography.
M. S. Karolyi, and D. C. Ford.
Journal of Hydrology, Vol. 61, No. 1-3, p 181-185,
February, 1983. 1 Fig. 4 Ref.

Descriptors: *Goose Arm, *Newfoundland, *Karst hydrology, *Groundwater movement, *Subsurface drainage, *Geohydrology, *Surface-groundwater relations, Hardness, Springs, Water temperature.

Karst landforms located at the head of Goose Arm, a major fjord, comprise 200 sq km of de-formed carbonates with relief of 60-350 m, blanket-ed with carbonate-rich till of the Last Glaciation. ed with carbonate-rich till of the Last Glaciation. Karst development is mature and well integrated: landforms include small ponors, small collapse, subsidence and suffosion dolines in till, and littoral karren at lake margins. Groundwater drainage is extremely disordered; there appear to be as many springs as there are sinkholes and the flowpaths are very short (200-2800 m). Gradient and orientation of the flowpaths display no systematic relationships to geologic structure. The anomaly is explained by injection of glacial till into a paleo-aquifer, clogging it. Karstic depressions are present over 70% of the 200 sq km area but only 13% of it is drained underground at all times. A further 40% is also drained underground, but with surface over-

flow during wet periods. Glacial till has effectively buffered postglacial runoff to inhibit the renewal of solutional attack upon the bedrock and the introduction of ordered drainage within it. Mean hardness of samples taken from surface water equals 98 mg/l (CaCO3 + MgCO3, expressed as CaCO3; distribution is ideally normal. The karst springs may be grouped into two principal classes by temperature. Springs grouped into the principal class of approximately 8 C are interpreted as circulating deeply and so attaining the ambient temperature of the rock. Springs of the principal class of 15-18 C are interpreted as flowing rapidly at very shallow depth. (Collier-IVI)

ALPINE KARST SYSTEMS AT CROWSNEST PASS, ALBERTA-BRITISH COLUMBIA, CANADA,

McMaster Univ., Hamilton (Ontario). Dept. of Ge-

Journal of Hydrology, Vol. 61, No. 1-3, p 187-192, February, 1983. 2 Fig, 5 Ref.

Descriptors: *Crowsnest Pass, *Alberta, *British Columbia, *Karst hydrology, *Geohydrology, *Groundwater movement, Caves, Aquicludes, Vadose water, Springs.

Vauose water, springs.

Crowsnest Pass is a deep E-W breach through a westerly dipping thrust plate of massive platform limestones that contains one major aquiclude stratum. Preglacial drainage was karstic, strike-orientation of the Pass in separate systems above and below the aquiclude. Alpine glacial cirque and trough valley entrenchment has disordered the aquifers. In different catchments there is now karst drainage down dip, against dip, aslant strike, or surface drainage. Karstic strike drainage survives where hydraulic gradients exceed 1:15. The aquiclude is breached at one side. Caves and other karst features are abundant at all elevations between the mountain crests and the floor of Crowsnest Pass. Passage fragments close to crest elevations rarely retain more than 100 m of gallery length. Larger fragmented cave systems at intermediate elevations may attain an aggregate gallery length of 5 km and may attain an aggregate gallery length of 5 km and a depth in excess of 300 m; these are fossil phreatic loop complexes which may channel small quanti-ties of vadose invasion water today. Modern active ues or vacose invasion water today. Modern active cave systems, which are largely inaccessible, are known by their springs or function as flood over-spill channels. Regional prediction of karstic flow in alpine terrains is problematic; simple model pre-dictions are unlikely to apply. (Collier-IVI) W85-00015

CASTLEGUARD KARST, MAIN RANGES, CA-NADIAN ROCKY MOUNTAINS, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography. C. C. Smart, and D. C. Ford. Journal of Hydrology, Vol. 61, No. 1-3, p 193-197, February, 1983. 2 Fig. 4 Ref.

Descriptors: *Castleguard karst, *Columbia Ice-field, *Rocky Mountains, *Glacial springs, *Karst hydrology, Geohydrology, Groundwater ment, Springa, Aquifer systems, Glaciers.

A major portion of the drainage from the Columbia Icefield is discharged through the bed of the subglacial Castleguard karst into well integrated cave conduits. The subglacial water is drained cave conduits. Ine subglacial water is drained through the karst to constricted springs in the Castleguard Valley. Spring discharge measurements reveal few discharges in excess of 1 cu m/s. Output at Big Spring (6.5 cu m/s maximum) showed diurnal oscillations in the discharge peaks which lagged 5-7 hours behind the diurnal peaks in the conventional claim and the claim and the claim and the claim which lagged 5-7 hours behind the diurnal peaks in the conventional glacial-melt rivers. During its peak flow periods, Big Spring displayed constant discharge and the periodic springs commenced flowing in diurnal pulses. Fluorescent dye injections confirmed a groundwater link between the cave springs and Big Spring; the linkage is not a simple distributary relationship. Measurements of flowthrough time to Big Spring from a site 4.5 km distant and 750 m higher yielded minimum mean velocities of 200 m/hr and 640 m/hr. These results

suggest that the phreas has very limited volume. There is little storage in the aquifer and its rapid response and recession indicate a sparse but well-integrated network of conduits. The springs are the principal drain of the central ice field. Karst flow systems may be maintained beneath temperate ice. The apparent immaturity of the springs is contradicted by their rapid response and recession, and by rapid groundwater velocities. The inferred age of 700,000 yr is also sufficient for conduit development. Recent glaciation has blocked a pre-existing conduit, throwing the aquifer into temporary disorder. (Collier-IVI) W85-00016

LINCOLNSHIRE LIMESTONE - HYDROGEO-CHEMICAL EVOLUTION OVER A TEN-YEAR PERIOD.

Hastitute of Hydrology, Wallingford (England). W. M. Edmunds, and N. R. G. Walton. Journal of Hydrology, Vol. 61, No. 1-3, p 201-211, February, 1983. 2 Fig. 1 Tab, 13 Ref.

Descriptors: *England, *Geochemistry, *Ground-water pollution, *Groundwater movement, *Chemical properties, Nitrates, Suffates, Calcium, Chlorides, Hydrogen ion concentration, Carbon-ates, Fluorides, Magnesium, Strontium, Hydrogen suffide, Groundwater withdrawal, Agricultural

In the Lincolnshire (Jurassic) Limestone of eastern England a sequence of hydrogeochemical processes along a 28-km flow line was defined in 1969. These processes include solution, redox and ion-exchange reactions, sulfate reduction, and mixing with saline formation water. Resampling in 1979 showed an almost exact replication of the hydrochemical profiles for pH, O2, HCO3(-), Na(+), Mg(2+), Sr(2+), F(-), and total mineralization. The NO3(-), SO4(2-), Cl(-), and Ca(2+) levels have all increased significantly downgradient, while the redox boundary has become less distinct, and an easterly shift of several kilometers for the first appearance of HS(-) is noticeable. Groundwatand an easterly shift of several kilometers for the first appearance of HS(-) is noticeable. Groundwater abstraction has stressed the natural system, and there now exists a dynamic equilibrium between the development induced recharge and the much older formation water. The principle changes in the hydrogeochemical controls can be attributed to over-development of the aquifer. A front of recent groundwater, contaminated by agrichemicals, has migrated eastwards giving rise to an increased concentration of Ca(2-), SO4(2-), NO3(-), and Cl(-). The aquifer has a significant capacity for in situ nitrate reduction. (Collier-IVI) W85-00017

TRACE-ELEMENT PARTITION COEFFI-CIENTS IN THE CALCITE-WATER SYSTEM AND THEIR PALEOCLIMATIC SIGNIFI-CANCE IN CAVE STUDIES,

McMaster Univ., Hamilton (Ontario). Dept. of Geography. M. Gascoyne.

Journal of Hydrology, Vol. 61, No. 1-3, p 213-222, February, 1983. 4 Fig. 2 Tab, 18 Ref.

Descriptors: *Caves, *Magnesium, *Geochemistry, *Calcite, *Paleoclimate, *Stalactites, *Groundwater, Ion exchange, Trace metals, Calcium, Deposition, Speleothems, Limestone, Air temperature,

Timing and intensity of past climates may be in-ferred from the mineral content of calcium carbonate precipitates formed in caves. These deposits, called spelcothems, include stalactites and stalagmites. The incorporation of certain trace elements (e.g., Mg, Mn and Zn) in calcite is known to be (e.g., Mg, Mn and Zn) m calcite is known to be temperature-dependent. Apparatus for collecting water and preconcentrating trace-metal cations was used for sampling drip-water from stalactites. Using specially developed ion-exchange sampling techniques, analysis of trace-metal content of seep-age water and associated fresh calcite deposits in caves in Vancouver Island and Jamaica shows that Mg is distributed between phases in a consistent Mg is distributed between phases in a consistent manner within the temperature regimes of the caves (7 degrees and 23 degrees C, respectively).

Field 2-WATER CYCLE

Group 2F-Groundwater

Average values of the distribution coefficient for Mg are respectively 0.017 and 0.045 at these temperatures. These results indicate that the Mg content of calcite varies directly with temperature and in a sufficiently pronounced manner that a 1 degree C rise in depositional temperature of a speleothem containing 500 ppm Mg, at approximately 10 degrees C, would be seen as an increase of approximately 35 ppm Mg - a readily determinable shift. Variations in trace-metal content of fossil speleothems is useful as an alternative paleotemperature indicator. (Collier-IVI) W85-00018

EFFECTS OF GEOMORPHOLOGY AND SEA-SONALITY ON THE CHEMISTRY OF CAR-BONATE GROUNDWATER, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography. J. J. Drake.

Journal of Hydrology, Vol. 61, No. 1-3, p 223-236, February, 1983. 5 Fig. 1 Tab, 12 Ref.

Descriptors: *Geochemistry, *Geomorphology, *Calcium, *Carbonates, *Carbon dioxide, *Seasonal variation, Groundwater chemistry, Soil gases, Temperature, Gases, Soil temperature, Groundwater recharge, Climates.

The equilibrium chemistry of carbonate ground-water at the regional and long-term scales of ag-gregation is affected by geomorphic factors and by the seasonality of temperature and recharge re-gimes. The general trend of Ca concentration dif-ferences between regions is governed by annual mean air or groundwater temperature and by the nature of the solution system. Higher Ca concennature of the solution system. Higher Ca concentrations result from the coincident system where carbonate material, soil air and water are all present together and lower Ca concentrations from the sequential system where carbonate material occurs downstream of the soil air. Coincident systems occur in areas where carbonate material is present in the regolith (either by natural or human activity), where a porous or friable bedrock lies at shallow depth or where soils are shallow. Sequential systems occur where there is a deep noncarbonate regolith. where there is a non-carbonate bonate regolith, where there is a non-carbonate cap to the carbonate bedrock or where there is a cap to the carbonate bedrock or where there is a high water table. The assumptions of a fixed soil-air CO2 production contained in a simple model of the chemistry of saturated groundwater in carbonate terrains is invalid where recharge occurs through soils with a small relative air volume, at low temperatures, and where solution occurs under coincident-system conditions. This model does explain the general patterns of variations between regions worldwide. Reductions in equilibrium Ca concentration can be caused by low soil-air um Ca concentration can be caused by low soil-air volumes relative to percolation volume. This may be particularly significant in cool regions, where soils are shallow and clayey, and where recharge occurs in short high-intensity events. (Collier-IVI) W85-00019

SALTWATER-FRESHWATER INTERFACE IN THE TERTIARY LIMESTONE AQUIFER, SOUTHEAST ATLANTIC OUTER-CONTINENTAL SHELF OF THE U.S.A.,

Geological Survey, Albany, NY. R. H. Johnston. Journal of Hydrology, Vol. 61, No. 1-3, p 239-249, February, 1983. 5 Fig. 13 Ref.

Descriptors: *Floridan aquifer, *Florida, *Georgia, *Saline-freshwater interfaces, Saline aquifers, Groundwater potential, Carbonate aquifers, Offshore, Groundwater reservoirs, Saline water intrusion, Chloride, Water rces development

The tertiary limestone aquifer of southeastern USA is a sequence of carbonate rocks from which more than 3 billion gal (approximately 11,400,000 cu m) of water are pumped daily. This aquifer system is the principal source of municipal, industrial, and agricultural water in south Georgia and most of Florida. Hydrologic testing in an offshore oil well determined the position of the saltwater-freshwater interface in Tertiary limestones underlying the Florida-Georgia continental shelf. At the offshore

well 55 mi (approximately 88 km) east of Fernandina Beach, Florida, drill-stem tests made in the interval 1050-1070 ft (320-326 m) below sea level in the Ocala Limestone recovered a sample with a chloride concentration of 7000 mg/l. Formation water probably is slightly fresher. Pressure-head measurements indicated equivalent freshwater heads of 24-29 ft (7.3-8.8 m) above sea level. At the heads of 24-29 ft (7.3-8.8 m) above sea level. At the coast (Fernandina Beach), a relatively thin transition zone separating freshwater and saltwater occurs at a depth of 2100 ft (640 m) below sea level. Fifty-five miles (approximately 88 km) off-shore the base of freshwater is approximately 1100 ft (approximately 35 m) below sea level. The differences in depth to the freshwater-saltwater transition at these two locations suggests an interface with a very slight landward slope. Assuming the Hubbert interface equation applies here (because the interface and therefore freshwater flow lines are nearly horizontal) the equilibrium denth to the the interface and therefore freshwater flow lines are nearly horizontal) the equilibrium depth to the interface should be 40 times the freshwater head above sea level. Using present-day freshwater heads along the coast in the Hubbert equation results in depths to the interface of less than the observed 2100 ft (640 m). Substituting predevelopment heads in the equation yields depths greater than 2100 ft (640 m). The interface is in a transient position between the position that would be compatible with present-day head and the position that would be compatible with predevelopment heads. Some movement of the interface from the predevelopment position has occurred during the past hundred the position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past supplement position has occurred during the past hundred processing the past hundred processing the past processing the past past processing the past processing the past past processing the past past processing the pa Some movement of the interface from the predeve-lopment position has occurred during the past hun-dred years. The implied movement is incompatible with the hypothesis that the freshwater occurring far offshore in this area is trapped water remaining since the Pleistocene Epoch. (Collier-IVI)

RELATION OF CONCEALED FAULTS TO WATER QUALITY AND THE FORMATION OF SOLUTION FEATURES IN THE FLORIDAN AQUIFER, U.S.A., NORTHEASTERN

Geological Survey, Jacksonville, FL. G. W. Leve. Journal of Hydrology, Vol. 61, No. 1-3, p 251-264, February, 1983. 7 Fig. 1 Tab, 15 Ref.

Descriptors: *Floridan aquifer, *Florida, *Chlorides, *Geologic fractures, *Solution features, *Saline water intrusion, Saline-freshwater interfaces, Demineralization, Carbonate aquifer, Artesian pressure, Calcite, Dolomite, Mineralization, Aquifers, Dissolution, Geochemistry, Groundwater movement, Water quality.

Geological and hydrological information on the Floridan aquifer in northeastern Florida indicates that isolated occurrences of water having relativethat isolated occurrences of water naving remuve-ly high chloride concentration in the upper part of the aquifer may be associated with buried faults. Water having chloride concentrations of more than 7000 mg/l occurs in the deeper zone of the aquifer at depths below approximately 600 m below sea level in the coastal and east-central part of the study ages. This deep salty water is under below sea level in the coastal and east-central part of the study area. This deep salty water is under higher artesian pressure than water in the shal-lower, generally freshwater zones, but it is restrict-ed from moving upward by relatively impermeable dolomite beds. Two buried faults with vertical displacements of 30-45 m are in areas where rela-tively high concentrations of chloride have been detected in water in the unper part of the aquifer. detected in water in the upper part of the aquifer. Geochemical, artesian pressure, and water temperature data show that the source of the relatively ature data show that the source of the relatively high concentrations of chloride in water in the upper part of the aquifer is from the deeper zone; the faults may have breached the dolomite confining beds and allowed the upward movement of salty water from the deeper zone. The upward movement of mineralized water along the faults may also have formed some of the solution features found in the aquifer near the faults. In this area, freshwater in the upper part of the aquifer is normally saturated with respect to calcite and dolomite. Water from wells tapping the upper part of the aquifer near the faults is not fully saturated suggesting that the mixing of deep mineralized water with shallower freshwater produces a mixture that is not saturated with respect to these minerals and allows for the dissolution of limestone in the aquifer near the faults. Dissolution of limestone in the aquifer near the faults. Dissolution of limestone stone may also be occurring at the freshwater-saltwater interface in the deeper zones of the aqui-fer. (Author's abstract) W85-00021

SULFUR ISOTOPES AND HYDROCHEMICAL VARIATIONS IN SPRING WATERS OF SOUTHERN INDIANA, U.S.A., Indiana Univ. at Bloomington. Dept. of Geology. N. C. Krothe, and R. D. Libra. Journal of Hydrology, Vol. 61, No. 1-3, p 267-283, February, 1983. 6 Fig. 4 Tab, 14 Ref.

Descriptors: *Indiana, *Geochemistry, *Ground-water movement, *Sulfur isotopes, *Spring water, Carbonates, Karst hydrology, Sulfates, Gypsum, Conduit flow, Diffuse flow, Sulfur bacteria, Hy-drogen sulfide.

Sulfur isotope data can be combined with hydrological and geochemical techniques to determine the sources of sulfate dissolved in a carbonate terrain. Water chemistry and delta S-34(SO4) studies sug-gest two flow systems in the karst terrain of south-ern Indiana: a conduit (shallow) flow system, dominated by surface water entering the ground through fractures; and a deeper regional ground-water flow system recharged by diffuse flow. The chemistry of the water in the regional system may be dominated by the solution of gypsum in the Lower St. Louis Limestone. Water chemistry and Lower St. Louis Limestone. Water chemistry and sulfur isotopes in the springs studied vary with flow type and discharge. The high SO4(2-) concentrations in local waters may result from solution of gypsum. Reported delta S-34(SO4) for Upper Mississippian evaporates and fresh water range from +14 to +19 to +8 to +12 0/00, respectively. Isotope analysis of gypsum cores from the Lower St. Louis Limestone evaporite unit shows delta S-34 values between +14.10 and +15.13 0/00 in the study area. Groundwater chemistry studies show a direct linear relationship between SO4(-2) concentrations and delta S-34 values. Groundwater varies in SO4(-2) concentrabetween SO4(-2) concentrations and delta S-34 values. Groundwater varies in SO4(-2) concentrations between 20 and 1970 mg/l. The delta S-34 values range from +10.61 0/00 for a conduit spring to +18.57 0/00 for a diffuse spring. The waters with high SO4(2-) concentrations have delta S-34(SO4)-values higher than the local gypsum deposits analyzed and contain H2S, suggesting a deeper flow system in which fractionation by bacterial reduction of SO4(-2) is occurring. Waters with low SO4(-2) concentrations have delta S-34(SO4) values in the range of local fresh waters, indicating a shallow flow system. (Collier-IVD W85-00022

NITROGEN-ISOTOPE ANALYSIS OF GROUNDWATER NITRATE IN CARBONATE AQUIFERS: NATURAL SOURCES VERSUS HUMAN POLLUTION,

Texas Univ. at Austin. Bureau of Economic Geol-

For primary bibliographic entry see Field 5B. W85-00023

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART IV, HYDRAULIC CHARACTER-ISTICS OF THE WILCOX-CARRIZO AQUI-Geological Survey, Baton Rouge, LA. Water Re-

sources Div. For primary bibliographic entry see Field 4B. W85-00034

BASIC GROUND-WATER HYDROLOGY, Geological Survey, Raleigh, NC. Water Resources R. C. Heath.

Available from Dist. Br., USGS, 604 S. Pickett St., Alex., Va. 22304. USGS Water-Supply Paper 2220, Second printing, 1984. 84 p, 10 Tab, 30 Ref.

Descriptors: *Groundwater, *Geohydrology, Groundwater pollution, *Aquifer characteristics, *Aquifer testing, Transmissivity, Permeability co-

Groundwater-Group 2F

efficient, Darcy's law, Water well hydraulics, *Groundwater movement, Thesis equation, Jacob equation, Water well problems.

equation, Water well problems.

This report has been prepared to help meet the needs of local, State and federal water managers, as well as the needs of hydrologists, well drillers, and others engaged in the study and development of ground-water supplies. It consists of 45 sections on the basic elements of ground-water hydrology, arranged in order from the most basic aspects of the subject through a discussion of the methods used to determine the yield of aquifers to a discussion of common problems encountered in the operation of ground-water supplies. Each section consists of a brief text and one or more drawings or maps that illustrate the main points covered in the text. In the sections dealing with the analysis of aquifer (pumping) test data, equations are given in both consistent units and in the inconsistent inch-pound units still in relatively common use among ground-water hydrologists and well drillers. As an aid to those who are not familiar with metric units and with the conversion of ground-water hydraulic units from inch-pound units to metric units, conversion tables are given on the inside back cover. Definitions of ground-water terms are given where the terms are first introduced. Abbreviated definitions are also given on the inside front cover for convenient reference by those who wish to review the definitions from time to time as they read the text. Finally, for those who need to review some of the simple mathematical operations that are used in ground-water hydrology, a section on numbers, equations, and conversions is included at the end of the text. (USGS)

GROUND-WATER REGIONS OF THE UNITED

Geological Survey, Raleigh, NC. Water Resources

Available from Supt. Documents, GPO, Washington, D.C. 20402. USGS Water-Supply Paper 2242, 1984. 78 p, 59 Fig, 6 Tab, 53 Ref.

Descriptors: *Groundwater reservoirs, *Ground-water availability, Geohydrology, *Groundwater regions, *Aquifer classification, Regional analysis, United States.

Features of ground-water systems useful in delineating ground-water regions include the components of the systems, the nature of the water-bearing openings, mineral composition of the rock matrix, water storage and transmission characteristics, and recharge and discharge conditions. Using these criteria the United States, Puerto Rico, and the Virgin Islands are divided into 15 ground-water regions. In addition to discussions of ground-water geology and the classification of ground-water systems, this report also contains a brief description of the physical features, geologic framework, and the principal aspects of ground-water occurrence in each region. (USGS) W85-00037

HYDROLOGY OF THE NEWBERRY VOLCA-NO CALDERA, OREGON, Geological Survey, Menlo Park, CA. Water Re-

Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Samuel, and R. W. Craig.
Available from the OFSS, USGS, Box 25425, Fed.
Ctr. Denver, CO 80225, USGS Water Resources
Investigation Report 83-4091, 1983. 52 p, 5 Fig, 12
Tab, 17 Ref.

Descriptors: *Geothermal resources, Hydrology, *Areal hydrogeology, Natural resources, Data collection, *Oregon, *Newberry Volcano, Cascade

Precipitation in the Newberry Caldera is very nearly in balance with evaporation, evapotranspiration, and streamflow. Calcium, magnesium, and bicarbonate ions predominate in the more dilute ground and surface water. Thermal waters from springs and wells have concentrations of 900 milligrams per liter or more and are characterized by high concentrations of sodium and sulfate. At-

tempts to account for the origin of the hot springs on the basis of mixing relations and isotopic analyses were inconclusive; the springs may represent mixtures of thermal and nonthermal water which are altered by gases rising from sources beneath the caldera floor. Annual recharge to deep aquifers beneath the caldera is probably in the range 2,500 to 6,500 acre-feet. Observations in a Geological Survey drill hole suggest that part of the water may flow to aquifers at depths as much as 1,900 feet beneath the caldera floor. Potential recharge to a postulated geothermal reservoir probably is extremely small. (USGS)

EFFECT OF WATER TABLE DEPTH IN OR-GANIC SOIL ON SUBSIDENCE / ND SWELL-

Department of Agriculture, Saint-Je*a (Quebec). Research Station. For primary bibliographic entry see Field 2G. W85-00156

HEAT AND MASS TRANSFER IN A FAULT-CONTROLLED GEOTHERMAL RESERVOIR CHARGED AT CONSTANT PRESSURE, Univ., Berkeley. Lawrence Berkeley

Lab.
K. P. Goyal, and T. N. Narasimhan.
Journal of Geophysical Research, Vol. 87, No.
Bl0, p 8581-8590, October, 1982. 11 Fig. 1 Tab, 29
Ref, 1 Append. DOE contract DE-AC0376SF00098.

Descriptors: *Geothermal studies, *Heat transfer, *Mass transfer, *Geothermal reservoirs, Boundary layers, Rayleigh number, Geologic fractures, Thermal water, Mathematical models.

A two-dimensional, generic-type model was developed for a liquid-dominated geothermal reservoir charged by heated water from a vertical fault zone and overlain by a thin, impermeable, thermally conducting cap rock. This model is applicable to a system with an impermeable clay cap orders of magnitude smaller than the underlying reservoir depth or to a system where the heated water is present in an extensive region just below the surface. The mass flow rate or the mressure associated depth or to a system where the heated water is present in an extensive region just below the surface. The mass flow rate or the pressure associated with the charging process at the fault inlet is unknown and can only be estimated and the pressure in the fault at the bottom of the reservoir is assumed to be prescribed. Quasianalytic solutions for the velocity pressure, and temperature are obtained in the fault-reservoir system for a high Rayleigh number flow. In this approximation, the upwelling fluid does not cool off appreciably until it reaches the cold upper boundary of the reservoir and encounters conductive heat loss. This thermal boundary layer, which is thin at the top of the fault, grows outward laterally and occupies the full thickness of the aquifer far away from the fault. The mathematical model is based on the flow of liquid water in a saturated porous medium. The liquid water in a saturated porous medium. The solution techniques involve the combination of perturbation methods, boundary layer theory, and numerical methods. (Collier-IVI) W85-00176

THEORY OF THE DEVELOPMENT OF GEOTHERMAL SYSTEMS CHARGES BY VERTI-CAL FAULTS, California Univ., Berkeley. Lawrence Berkeley

G. S. Bodvarsson, S. M. Benson, and P. A.

Witherspoon.
Journal of Geophysical Research, Vol. 87, No. B11, p 9317-9328, November, 1982. 17 Fig. 1 Tab, 14 Ref, 2 Append. DOE contract DE-AC03-76SF00098.

Descriptors: *Geothermal studies, *Geologic fractures, *Susanville, *California, Heat transfer, Recharge, Boundary layers, Thermal water, Mathematical models.

A two-dimensional model has been developed of horizontal aquifers recharged with hot water by a vertical fault. The model considers the transient development of such systems including the effects

of heat losses to the confining layers. The model can be used for theoretical studies of the development of fault-charged reservoirs. It can also be ment of fault-charged reservoirs. It can also be used to estimate the rate of recharge from the fault source and the time of evolution, using temperature data from wells. The evolution of the thermal field is greatly dependent on the ratio of the heat capacity of the aquifer to that of the caprock; the lower the ratio, the greater the heat losses from the aquifer to the caprock and bedrock. A steady state temperature field is greatly dependent on the distance to the constant temperature bundary conditemperature field is greatly dependent on the dis-tance to the constant temperature boundary condi-tion at the ground surface. The model has been applied to the hydrothermal system at Susanville, California. A reasonable match with the areal tem-perature distribution in the primary aquifer and the temperature profiles of individual wells was ob-tained. This allowed an estimate of the recharge rate from the fault into the hydrothermal system to be obtained. As the calculated recharge rate be obtained. As the calculated recharge rate (0.000009 cu cm/s m) into the Susanville hydrothermal system proved to be quite significant, a threefold increase in the potential of the Susanville hydrothermal anomaly for space heating purposes is predicted. (Collier-IVI) W85-00177

FLUCTUATION OF THE GROUNDWATER LEVEL AND FRESH-SALT WATER INTER-FACE IN RESPONSE TO THE TIDE (IN JAPA-

Ehime Univ., Matsuyama (Japan). Dept. of Applied Physics.
Y. Kishi, and K. Inouchi.

Japanese Journal of Limnology, Vol. 45, No. 1, p 61-68, January, 1984. 12 Fig. 15 Ref.

Descriptors: *Model studies, *Groundwater move-ment, *Saline-freshwater interfaces, *Tidal effects, Water level, Confined aquifers, Unconfined aquifers, Aquifers.

aquifers, Aquifers.

A model was used to investigate the fluctuation of groundwater level and fresh-salt water interface in response to tidal influences. The model assumes that groundwater is composed of two immiscible fluids, fresh water and salt water, in unconfined and confined coastal aquifers. Solving mathematical approximations of groundwater flow produces simple analytical forms which express the fluctuation of the groundwater level and fresh-salt water interface in response to the harmonic oscillation of the level of the sea. Numerical solutions of groundwater flow are then obtained and the results compared with simple analytical solutions. Fluctuation of the groundwater level was almost the same as that predicted from the model in which groundwater is assumed to be composed of only a single fluid. Amplitude and phase lag of the oscillation of the fresh-salt water interface are nearly the same as those of the groundwater level in the case of the unconfined aquifer. In the case of the confined aquifer, on the other hand, amplitude of the fresh-salt water interface is considerably smaller and the phase lag is about 45 degrees compared with those of the groundwater level. (Baker-IVI)

PUMPING TESTS IN PATCHY AQUIFERS, Institute of Geological Sciences, London (England). Hydrogeology Unit. For primary bibliographic entry see Field 4B. W85-00300

PROGRAMMABLE HAND CALCULATOR PROGRAMS FOR PUMPING TEST ANALYSES BY LEAST SQUARES' METHOD USING JACOB'S MODIFICATION OF THEIS' EQUA-

King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences. For primary bibliographic entry see Field 4B. W85-00301

HYDRAULIC CONDUCTIVITY OF A GLACIAL

TILL IN ALBERTA,
Department of Agriculture, Lethbridge (Alberta).
Irrigation Div.

Field 2-WATER CYCLE

Group 2F—Groundwater

For primary bibliographic entry see Field 4B. W85-00302

LOWER HAWTHORN AQUIFER ON SANIBEL ISLAND, FLORIDA, Law Engineering Testing Co., Marietta, GA. For primary bibliographic entry see Field 4B. W85-00303

HYDRAULIC CONDUCTIVITY OF A FINE-GRAINED TILL, CATTARAUGUS COUNTY, NEW YORK,

Geological Survey, Carson City, NV. D. E. Prudic.

Ground Water, Vol. 20, No. 2, March-April, 1982. 7 Fig, 3 Tab, 18 Ref.

Descriptors: "Tills, "Permeability coefficient, "Cattaraugus County, "New York, Landfills, Ra-dioactive waste disposal, Slug tests, Groundwater movement, Porosimeter tests, Anisotrophy, Over-

Hydraulic conductivity of a fine-grained till was evaluated by field and laboratory techniques as part of a study of the movement of radionuclides at a nuclear-waste landfill in western New York. In a nuclear-waste landfill in western New York. In general, both methods produced similar results. Hydraulic conductivity values determined from (a) slug tests of piezometers, (b) several types of laboratory tests on cores, and (c) calculation from mercury porosimeter tests, agreed within a factor of 25. Slug tests were analyzed by two methods: one assumed horizontal flow to the piezometer screez, the other assumed spherical, isotropic flow. Average horizontal hydraulic conductivity from slug tests of 12 piezometers was 6 x 10 to the -8 cm/s by the second. Laboratory tests of core samples were designed to determine the extent to which anisotrophy and increased pressures with depth may affect hydraulic conductivity. Consolidation tests were done on four core samples to determine changes in hydraulic conductivity with pressure. tests were done on four core samples to determine changes in hydraulic conductivity with pressure. Vertical hydraulic conductivity of the samples decreased by 40% as pressure increased from near atmospheric to the 7 kg/sq cm 2, a pressure that would prevail at a depth of 30 m. This indicates that hydraulic conductivity of the till decreases with depth in response to overburden pressure. Despite evidence of higher horizontal than vertical permeability in one set of laboratory tests of till samples, other laboratory and field tests as well as analyses of ground-water flow by a computer model indicate that the till is nearly isotropic. Hydraulic conductivity of the till was estimated with reasonable accuracy from mercury-porosime-Hydraulic Conductivity of the fill was estimated with reasonable accuracy from mercury-porosimeter tests. However, estimating hydraulic conductivity of fine-grained samples from some regions by this method may be inappropriate because the method uses dry samples, which could severely affect the results if swelling clays are present. (Author's abstract) W85-00305

CALCULATION OF VELOCITY IN THREE SPACE DIMENSIONS FROM HYDRAULIC HEAD MEASUREMENTS,

Priaceton Univ., NJ. Dept. of Civil Engineering. L. M. Abriola, and G. F. Pinder. Ground Water, Vol. 20, No. 2, p 205-213, March-April, 1982. 5 Fig. 2 Tab, 1 Ref. 3 Append.

Descriptors: *Velocity, *Groundwater movement, *Hydraulic head, *Three dimensions, Mathematical studies, Vertical head gradient, Aquifer sys-

When an aquifer system exhibits a significant verti-cal head gradient, it is generally necessary to con-sider velocity components in three space dimen-sions. A systematic and straightforward method was developed for the estimation of velocity com-ponents in three dimensions from hydraulic head data from a network of wells screened at different elevations. Groups of four measurement points are connected to form tetrahedrons, and a linear inter-polation scheme is used to obtain a head gradient polation scheme is used to obtain a head gradient estimate for each tetrahedron. Application of Darcy's law then yields the desired velocity com-

ponent values. In the absence of significant vertical gradients, a two-dimensional approach will be roughly equivalent, and the simpler two-dimensional approach may be used with confidence. (Moore-IVI)

REPEATED PULSE TECHNIQUE FOR DE-TERMINING THE HYDRAULIC PROPERTIES OF TIGHT FORMATIONS, Arizona Univ., Tucson. Dept. of Hydrology and

Water Resources.
G. R. Walter, and G. M. Thompson.
Ground Water, Vol. 20, No. 2, p 186-193, March-April, 1982. 10 Fig, 1 Tab, 10 Ref.

Descriptora: *Hydraulic properties, *Repeated pulse method, *Aquifer testing, Geohydrology, Transmissivity, Observation wells, Groundwater storage, Anisotrophy, Slug tests.

Slug and bailer tests are being used increasingly to evaluate the hydraulic properties of 'tight' geologic units. Although these pulse methods of stressing a system are used typically only on single wells, the repeated pulse method described here stresses the system in the same manner, but the response is the system in the same manner, but the response is measured in observation wells. This type of pulse test yields much the same information as conventional pumping tests, but it is easier to perform in very low permeability units. The observation well response hydrographs are analyzed by curve-matching techniques. In general, a unique set of type curves must be computed for each pulse test. These types curves are computed easily if the pulsed well is treated as a line-source (or sink). The accuracy of the value of transmissivity CD determined to the pulse of the pulse of transmissivity CD determined to the pulse of the pulse of transmissivity CD determined to the pulse of the pulse of transmissivity CD determined to the pulse of the pulse accuracy of the value of transmissivity (T) deter-mined from the line-source type curves compared mined from the mine-source type curves compared to using the finite-diameter well solution depends both on the pulsed well radius (rc) and the time interval between pulses (delta t). If T delta t/rc sq is maintained greater than 50, then T determined from the line-source solution will be within 25% of that determined from more accurate, but computathat determined from more accurate, but computa-tionally inconvenient, finite-diameter well type curves. The repeated-pulse test technique was ap-plied to an experimental well array completed in the Conssauga Shale Formation at Oak Ridge Na-tional Laboratory. Values of transmissivity deter-mined by the repeated-pulse method agreed well with the results of slug tests performed on each well individually, and in addition, provided infor-mation on storage coefficients and anisotrophy at the site. (Author's abstract) W35-00308

TYPE CURVES FOR LARGE-DIAMETER WELLS NEAR BARRIERS,

King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences.

Z. Sen. Ground Water, Vol. 20, No. 3, p 274-277, May-June, 1982. 3 Fig, 5 Ref.

Descriptors: *Aquifers, *Groundwater movement, *Wells, Barriers, Mathematical equations, Darcy's Law, Depression cone volume.

Large-diameter well with well storage are frequently encountered in finite aquifers. A new methodology is presented for deriving the relevant type curves for this situation. In the Mid-East, large-diameter wells are mostly hand dug with sarge-quameter wens are mostly nand oug with diameters of 1 to 3 meters. The continuity equation and Darcy's law are used, coupled with the image method and the depression cone volume. The re-sultant type curve equation is very simple and lends itself to calculation on an ordinary hand calculator. There is no need for any table to alor calculator. There is no need for any table to plot the required type curve. Comparisons with the corresponding type curves in an infinitely extensive aquifer have been given. (Baker-IVI) W85-00310

SULFATE-REDUCING BACTERIA IN GROUND WATER FROM CLOGGING AND NONCLOGGING SHALLOW WELLS IN THE NETHERLANDS RIVER REGION,

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands).

For primary bibliographic entry see Field 4B.

ANALYSIS OF LEAKY AQUIFER PUMPING TEST DATA: AN AUTOMATED NUMERICAL SOLUTION USING SENSITIVITY ANALYSIS,

Kansas State Geological Survey, Lawrence. P. M. Cobb, C. D. McElwee, and M. A. Butt. Ground Water, Vol. 20, No. 3, p 325-333, May-June, 1982. 7 Fig. 2 Tab, 18 Ref, 1 Append.

Descriptors: *Pumping tests, *Leaky aquifers, *Drawdown, Confined aquifers, Mathematical models, Computer models, Sensitivity analysis, Al-

A methodology for analyzing the leaky artesianaquifer pumping test uses a numerical regression algorithm built on sensitivity analysis. A by-product is the solution to the drawdown equations. The algorithm has consistently proven its ability to converge the correct set of aquifer parameters for a typical data set. In this case correct means the values obtained by manual curve matching methods for real data, or the values used in generating the hypothetical data. Initial estimates of the aquifer parameters may vary by about three orders of magnitude above or below the correct values. For typical data sets the rms fitting error should be less than a few tenths of a foot. If this is not the case, one is probably not dealing with a simple leaky aquifer. If the data diverge too much from ideal data, convergence may not occur; if convergence uct is the solution to the drawdown equations. The aquifer. If the data diverge too much from ideal data, convergence may not occur; if convergence does occur, the rms error may be unacceptable. Since the three degrees of freedom (three aquifer parameters) give the algorithm considerable latitude in achieving convergence, an imperfect data set may be run successfully and a set of values for transmissivity, storage, and leakage produced. For this reason, only the best data available should be analyzed, and the geohydrology should be examined by experienced personnel. (Moore-IVI) W85-00315

REPRESENTATION OF MULTIAQUIFER WELL EFFECTS IN THREE-DIMENSIONAL GROUND-WATER FLOW SIMULATION,

Geological Survey, Reston, VA. For primary bibliographic entry see Field 4B. W85-00316

COMPACT MODIFIED THREE-DIMENSION-AL AQUIFER SIMULATION PROGRAM FOR SMALL COMPUTERS,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.

B. H. Briz-Kishore, and R. V. S. S. Avadhanulu

Ground Water, Vol. 20, No. 3, p 342-344, May-June. 1982. 3 Fig. 1 Ref.

Descriptors: *Groundwater movement, *Computers. *Simulation. Aquifers. Computer models. ers, *Simulation, Aquifers, Computer Three-dimensional models, Geohydrology.

The three-dimensional ground-water flow model, developed by Trescott (U.S.G.S. Open-File Report 75-438, 1975) simulates aquifers with heterogenous, anisotropic character having irregular boundaries. The program requires about 250K bytes of memory for compilation and 72K bytes of memory for execution on IBM/370 using FORTRAN H OPT 2 system. To popularize the program for minicomputers, the entire organization was restructured and various programming facilities were minicomputers, the entire organization was restructured and various programming facilities were used. The implementation of segmentation and overlay at job command level, design of new subroutines, and regrouping of the entries at program peripheral level and availing of program facilities have significantly reduced the program code. The new program requires about 11K bytes of memory. The modified design was tested with an example from Trescott and achieved 80% memory optimization with a slight increase of run time. The zation with a slight increase of run time. The efficiency of the developed methodology is established by the identical results obtained. (Moore-W85-00317

Groundwater-Group 2F

CLASSIFICATION OF GROUND-WATER SYSTEMS OF THE UNITED STATES, Geological Survey, Raleigh, NC. Water Resources

Div. R. C. Heath.

Ground Water, Vol. 20, No. 4, p 393-403, July-August, 1982. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Groundwater systems, *Classifica-tion, Geohydrologic units, Mapping, Discharge, Recharge, Groundwater storage, Transmissivity, Geohydrology.

Delineation of groundwater regions is one of the most effective tools for transferring knowledge and for enhancing public understanding of groundwater occurrence and availability. The five features of groundwater systems useful in classification are: components of the system, nature of the water-bearing openings, composition of the rock matrix, storage and transmission characteristics, and recharge and discharge conditions. Using these features, the United States can be divided conveniently into 14 regions: Western Mountain Ranges; Aluvial Basins; Columbia Lava Plateau; Colorado Plateau and Wyoming Basin; High Plains; Nonglaciated Central Region; Glacated Central Region; Pledmont and Blue Ridge; Northeast and Superior Uplands; Atlantic and Gulf Coastal Plain; Southeast Coastal Plain; Alluvial Valleys; Hawaii; and Alaska. (Moore-IVI)

REGIONAL STUDY OF THE DAKOTA AQUI-FER (DARTON'S DAKOTA REVISITED),
Geological Survey, Lawrence, KS. Water Re-

Geological Survey, Lawrence, R.S. Water Resources Div. J. O. Helgesen, D. G. Jorgensen, R. B. Leonard, and D. C. Signor. Ground Water, Vol. 20, No. 4, p 410-414, July-August, 1982. 6 Fig. 14 Ref.

Descriptors: *Dakota aquifer, *Geohydrology, Aquifer characteristics, Potentiometric level, Con-fined aquifers, Water supply development.

The Dakota aquifer is an important resource to the midwestern U.S. Early work of N. H. Darton was a significant contribution to understanding the hydrology of the system. Since Darton's work, many investigators have studied Dakota-aquifer hydrology with regard to development of local or state-wide resources. Preliminary mapping of relatively recent fluid-level data indicates regional potentionetric trends similar to those interpreted by Darton, but altitudes substantially lower in part of the area. The classic artesian-system concept of the the area. The classic artesian-system concept of the Dakota aquifer is not consistent with some of the Dakota aquifer is not consistent with some of the data and observations of the past several decades. The simple aquifer geometry and effective lateral hydraulic continuity normally associated with that concept do not appear to characterize the Dakota aquifer regionally. Questions remain with regard to the significance of hydraulic head distributions, flow patterns, rates and distribution of recharge and discharge, geochemical processes, and water-quality variations. (Moore-IVI)

STATISTICAL IDENTIFICATION OF HY-DRAULIC CONNECTIONS BETWEEN THE SURFACE OF A MOUNTAIN AND INTERNAL MINERALIZED SOURCES, Idaho Univ., Moscow. Coll. of Mines and Earth

R. E. Williams. Ground Water, Vol. 20, No. 4, p 466-478, July-August, 1982. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Mining, *Molybdenum, *Block caving, *Water pollution sources, *Geohydrology, *Mount Emmons, *Colorado, Groundwater pollution, Springs, Mine drainage, Water quality, Geo-

Mount Emmons (near Crested Butte, Colorado) is the site of a proposed molybdenum mine that would extract ore from within the core of the 12,000-foot plus peak. The ore body will be ex-tracted using a block caving technique that re-quires a thorough understanding of the hydrology

of the mountain. To test the hypothesis that water quality data from various sources can be clustered and grouped into distinct populations that can be correlated with hydrogeologic features, cluster analysis and canonical analysis are applied to mine water quality data, drillhole water quality data, springwater quality data and surface-water quality data. Identified subpopulations indicate the presence or absence of mineralized sources in recharge areas, along flow paths or in discharge areas for the different water quality groups. The statistical analyses in combination with fault-vein mapping and debris slide mapping facilitate identification of preferential hydraulic connections between the surface of Mount Emmons and internal mineralized zones. The majority of the springs on Mount Emmons were derived from debris slides. These springs discharge water than meets drinking-water standards, and they should not be affected by mining are located in the vicinity of the iron bog and the ferricrete soils and the Keystone and Union fault veins on the south side of the mountain. On the north side of the mountain both springs in Redwell basin appear to be fault-controlled and probably would be impacted by mining if block caving were to extend sufficiently far north. (Moore-IVI)

UNRELIABILITY OF OPEN OBSERVATION BOREHOLES IN UNCONFINED AQUIFER PUMPING TESTS, Birmingham Univ. (England). Dept. of Civil Engi-

For primary bibliographic entry see Field 4B. W85-00331

HAND CALCULATOR PROGRAM FOR EVAL-UATING THEIS PARAMETERS FROM A PUMPING TEST, Electronic Associates, Inc., West Long Branch,

For primary bibliographic entry see Field 4B. W85-00332

EVALUATION OF AQUIFER BEHAVIOR IN A TYPICAL CRYSTALLINE BASEMENT,

TYPICAL CRYSTALLINE BASEMENT, Osmania Univ., Hyderabad (India). Centre of Ex-ploration Geophysics. B. H. Briz-Kishore, and V. L. S. Bhimasankaram. Ground Water, Vol. 20, No. 5, p 563-568, Septem-ber-October, 1982. 7 Fig, 3 Tab, 10 Ref.

Descriptors: *Crystalline basement, *Aquifer characteristics, *India, Drilling, Well yield, Cone of depression, Groundwater level, Laminar flow, Pumping tests, Surface-groundwater relations, Geologic fractures.

A systematic overal' study of aquifer characteristics, the flow and yields of groundwater in fractured crystalline rocks was conducted in a small area of 40,000 sq m in Shadnagar basin (India). The area represents a typical crystalline basement. The study area consists of a central pumping well and six observation wells placed in three different directions and at different distances. The water levels in all the wells observed during drilling rise after drilling is completed. Yields of the multilevel wells indicate that they are independent of the thickness of the weathered zone and the number of fractured zones. The observation of laminar flow, steady-state condition, and cone of depression fractured zones. The observation of laminar flow, steady-state condition, and cone of depression during pumping revealed that the fractured aquifer responds similarly to a continuous porous medium. Saturation and dewatering of the aquifer system over a long period results in the continuity of the entire groundwater system. The cone of depression may change in response to fracture orientation and configuration of the surface drainage system. The fracture system is in hydraulic connection with surface water in streams after pumping. (Moore-IVI) IVI) W85-00334

TRACING FLUID SOURCES IN THE EAST SHORE AREA, UTAH, Oak Ridge National Lab., TN. D. R. Cole.

Ground Water, Vol. 20, No. 5, p 586-593, September-October, 1982. 8 Fig, 1 Tab, 15 Ref. DOE contract DE-AC07-80ID12079.

Descriptors: *East Shore, *Utah, *Hot springs, *Warm springs, *Groundwater, Oxygen isotopes Deuterium, Hydrogen, Cations, Anions, Geohydrology, Groundwater movement.

drology, Groundwater movement.

Stable isotope and fluid chemistry investigations in complex hydrogeologic areas have proven useful in delineating the origin of thermal waters and their interaction with local ground-water reservoirs. The application of these techniques is illustrated using water samples collected from all hot and warm springs and many of the wells in the East Shore area, Utah. These samples were analyzed for major cations and anions, oxygen-18/oxygen-16 and deuterium/hydrogen ratios. The data presented suggest the presence of at least two and perhaps three distinct hydrogeologic regimes. One regime involves fault-controlled deep circulation of waters derived from high elevations in mountains toward the east. These waters evolved into the sodium plus potassium, chloride-enriched hot spring fluids that are high in total dissolved salt concentration (greater than 4,000 mg/l), exhibit oxygen-18 enrichment due to geochemical rockwater interaction at depth and have deuterium/hydrogen ratios similar to high elevation mountain springs. A second hydrogeologic regime is comprised of waters derived from lower elevations that infiltrate into the shallow valley sediments. These dilute calcium plus magnesium, bicarbonate fluids comprise most of the area's ground-water supply. Leakage of thermal waters into overlying cooler aquifers is observed in the vicinity of the hot springs, and is believed to occur in several other portions of the East Shore area. These leakage zones make up the third hydrogeologic regime portions of the East Shore area. These leakage zones make up the third hydrogeologic regime observed in the East Shore area. (Author's abstract) W85-00337

IN-SITU DETERMINATION OF THREE-DI-MENSIONAL AQUIFER PERMEABILITIES,

Insitu Consulting, Laramie, WY. S.-C. Way, and C. R. McKee. Ground Water, Vol. 20, No. 5, p 594-603, September-October, 1982. 12 Fig, 3 Tab, 13 Ref.

Descriptors: *Groundwater movement, *Aquifer properties, *Permeability, Testing, Mathematical equations, Groundwater flow, Flow.

In conventional methods of aquifer tests, hor In conventional methods of aquifer tests, homogeneous and isotropic formations are assumed. However, in many instances, aquifers are anisotropic. Three dimensional flow equations are derived to resolve this problem in homogeneous, anisotropic and leaky aquifers. With the equation and method as outlined, the three components of directional permeability can be determined in the presence of leakage, and the statistical distribution of fractures and stream channels can be determined. The directional and stream channels can be determined. The directional permeability of the formation is analyzed by matching the field drawdown (or pressure buildup data) against one of the type curves generated by the computer. The drawdown data (or pressure buildup data) against one of the type curves generated by the computer. The drawdown data (or pressure the computer. The drawdown data (or pressure buildup data) may be obtained in partially penetrat-ing observation wells near a partially penetrating pumped well. An example using the partial pene-tration well function on an in-situ mining property to evaluate directional permeability demonstrated excellent agreement between field data and type curves generated from the equation on the comput-er, thus verifying the method as presented. (Baker-IVD) IVD W85-00338

DOWN HOLE FLOWMETER ANALYSIS USING AN ASSOCIATED CALIPER LOG, Department of Scientific and Industrial Research, Taupo (New Zealand). Geophysics Div.

Ground Water, Vol. 20, No. 5, p 606-610, September-October, 1982. 3 Fig, 4 Ref.

Field 2-WATER CYCLE

Group 2F-Groundwater

Descriptors: *Permeability coefficient, *Flow-meters, *Geothermal wells, Mathematical equations, Caliper logs, Groundwater movement.

A flowmeter has been constructed for use in geo-A flowmeter has been constructed for use in geothermal wells and an interpretation technique developed for analyzing the logs. Because the geothermal wells are lined with alotted casing, which has an open annulus behind it, caliper logs are not easily obtained. The interpretation method as presented does not require borehole diameter information to derive volumetric flowrates. Location of constant flow regions, inflow and outflow zones is done by manually comparing the shapes of the caliper and flowmeter logs. A flowrate log is then produced using quantitative volumetric flowrates calculated for several depths in the well. The log lontains all the significant flow information without spurious noise and would be suitable for converting to an apparent hydraulic conductivity log. verting to an apparent hydraulic conductivity log. (Baker-IVI) Wes notan

HYDROGEOLOGIC CONTROL OF LOCAL-IZED IRON-ENRICHED GROUND WATER, LIMA, OHIO, For primary bibliographic entry see Field 4B. W85-0342

IDENTIFICATION OF RECHARGE AREAS USING GEOCHEMICAL FACTOR ANALYSIS. Kentucky Geological Survey, Lexington. F. W. Lawrence, and S. B. Upchurch. Ground Water, Vol. 20, No. 6, p 680-687, November-December, 1982. 3 Fig. 1 Tab, 19 Ref.

Descriptors: *Factor analysis, *Groundwater re-charge, *Floridan Aquifer, Permeability, Artificial recharge, Limestone, Geochemistry, Groundwater

ctor analysis is useful for interpreting com ractor analysis is useful to interpreting commonly collected groundwater quality data and relating those data to specific hydrogeologic processes. One hundred nine groundwater quality samples from wells completed in the upper Floridan Aquifere near Live Oak, Florida were analyzed for major dissolved constituents. R-mode factor analysis assessment to essentiate those who into territorials. major dissolved constituents. R-mode factor analysis was used to separate those chemical variables that reflect areally-significant recharge processes from those related strictly to the dissolution of aquifer materials. Areas impacted by direct, rapid, artificial recharge through drainage wells and sinkholes, as well as by slow, natural recharge into the Floridan Aquifer were delineated. In spite of the relatively low amount of variability accounted for in the analysis several clear natterns of recharge. radiatal Aquaite were utentated. In spin of the relatively low amount of variability accounted for in the analysis, several clear patterns of recharge are apparent. These patterns demonstrate the utility of factor analysis as a data filtering and pattern recognition technique. Factor analysis aids in sorting out chemical variables related to hydrogeological processes beyond strict lithologic controls. The technique applied to the Floridan Aquifer confirmed that recharge rates and pathways are related to topographic regions, identified possible fracture traces that influence recharge and groundwater movement, and delineated areas in the vicinity of Live Oak where groundwater is impacted by artificial recharge from urban and agricultural sources. This technique is useful only in combination with sound chemical principles and procedures. (Baker-IVI) W85-00345

GROUND-WATER AGE DISTRIBUTION IN MADRID BASIN, SPAIN, Universidad Autonoma de Madrid (Spain). Dept.

de Geologia. M. R. Llama mas, E. S. Simpson, and P. E. Martin

Alfaro.

Ground Water, Vol. 20, No. 6, p 688-695, November-December, 1982. 4 Fig. 4 Tab, 11 Ref.

Descriptors: *Groundwater dating, *Solute transport, *Madrid Basin, *Spain, Model studies, Carbon radioisotopes, Alluvial deposits, Fluvial sediments, Basins, Groundwater movement. A flow net and a discrete-state compartment (or mixing cell) model were employed to calculate the

age distribution of groundwater circulating through the aquifer formed by alluvial deposits that occupy the Madrid Basin in central Spain. Carbon-14 decay ages were determined for nine groundwater samples taken from eight locations. The ages obtained by the flow and mixing cell models were consistent and generally agreed with the ages obtained by C-14 studies. The disagreement of C-14 age in one sample possibly was caused by some contamination with modern water during sampling. The older age anomaly in another sample might have been caused by the long time required by the recharge water to pass through the unsaturated zone in the interfluves where this zone may be 100 m thick. Although a better adjustment of the C-14 data is desirable, it is not certain that this refinement will permit a better calibration of any of the models. It is more important to use the any of the models. It is more important to use the results of such studies to guide the design of future C-14 field sampling programs. The mixing cell model coupled with a flow model could provide a simplified method to analyze solute transgroundwater. (Baker-IVI)
W85-00346

SENSITIVITY ANALYSIS AND THE GROUND-WATER INVERSE PROBLEM,

Kansas State Geological Survey, Lawrence.

Kansas State Geological val. (2), C. D. McEllwee. Ground Water, Vol. 20, No. 6, p 723-735, November-December, 1982. 4 Fig. 1 Tab, 28 Ref.

Descriptors: *Sensitivity analysis, *Model studies, *Groundwater hydrology, Evaluation, Mathematical studies, Error analysis, Transmissivity, Storati-

An indirect inverse method using sensitivity analysis is employed to help understand the reasons for model insensitivity. The results of sensitivity analysis allow the modeler to delineate insensitive areas of the model where inverse procedures will be or the model where inverse procedures will be more subject to error. Sensitivity coefficients are defined and discussed. A differential equation is developed for the sensitivity coefficients that will generally be solved by numerical techniques. A relatively simple least squares' inverse procedure is used on a hypothetical model to illustrate typical problems that can be encountered. In activation used on a hypothetical model to illustrate typical problems that can be encountered. In particular, the effect of data accuracy is considered. The fact that considerable error in the transmissivity and storativity may occur in areas of low sensitivity should not be looked upon as a failing of the inverse procedure. It is simply a fact that not all areas of the model have been stressed equally. Until additional head data become available to establish a minimum sensitivity level in all areas of establish a minimum sensitivity level in all areas of Until additional head data become available to establish a minimum sensitivity level in all areas of the model it simply is not possible to estimate accurately the transmissivity and storativity everywhere. The inverse process may also experience problems due to a basic nonuniqueness near no-flow boundaries. The main advantage of the present work is that areas of low sensitivity may be delineated. (Baker-IVI) W85-00350

ISOTOPES IN GROUND-WATER INVESTIGA-

TIONS, Geological Survey, Reston, VA.

Ground Water, Vol. 20, No. 6, p 740-745, November-December, 1982. 5 Fig, 34 Ref.

Descriptors: *Isotope studies, *Groundwater, Reviews, Tracers, Isotopic tracers, Environmental tracers, Groundwater movement, Mixing, Water

Isotopes have been used during the past 20 years to obtain a better theoretical and practical understanding of groundwater. For an isotope to be useful in hydrology, the following characteristics are necessary. First, the relative mass difference of common to rare isotopes of the element should be large. Second, the abundance of the rare isotope must be substantial, but still contrast with the dominant isotope. Third courses were the substantial of the substantial inant isotope. Third, occurrence of some natural process modifies the relative abundance of an element's isotopes in a system. The distribution of isotopic species in water provides information on sources of groundwater, on flow paths and mixing,

and on physical and chemical characteristics of aquifers. Numerous examples in the literature illustrate the techniques and applications of isotopes to groundwater studies. Demands are increasing for better understanding of hydrologic systems to facilitate management of water as a resource, and to evaluate environmental problems. (Baker-IVI) W85-00351

GROUND-WATER DISPERSION CALCULA-TIONS WITH A PROGRAMMABLE CALCULA-TOR.

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering. W. E. Kelly.

Ground Water, Vol. 20, No. 6, p 736-738, November-December, 1982. 2 Tab, 3 Ref.

Descriptors: *Groundwater movement, *Error analysis, *Dispersion, Computers, Mathematical methods.

A simple and convenient method is presented for calculating two-dimensional dispersion on a TI 58 or 59 programmable calculator. Accurate values for the complementary error function may be obtained quickly using the solid state softwater program available in the Master Library module. With this capability, analytic expressions for dispersion may be easily evaluated and programs for computing one- and two-dimensional dispersion developed. An example is offered to show the type of results that may be obtained. The program retains the limitations of the analytic solution and the approximation of the well function. (Baker-IVI) W85-00352

FIELD DETERMINATION OF AQUIFER THERMAL ENERGY STORAGE PARAM-

Kansas Univ., Lawrence. Dept. of Civil Engineering.

A. D. Parr, F. J. Molz, and J. G. Melville.

Ground Water, Vol. 21, No. 1, p 22-35, January-February, 1983. 14 Fig, 3 Tab, 30 Ref. Battelle Pacific Northwest Laboratories contract B-67770-A-0, Oak Ridge National Laboratory contract

Descriptors: *Aquifer characteristics, *Thermal capacity, *Thermal energy storage, Energy sources, Evaluation, Permeability, Thermal conductivity, Pumping tests

Extensive testing is required to evaluate the potential of an aquifer for thermal energy storage. Important parameters include the regional gradient, vertical and horizontal permeability of the storage aquifer, horizontal dispersivity, vertical permeability of the upper and lower aquitard, thermal conductivities, heat capacities, and chemical characteristics of the aquifer matrix and native ground water. Procedures and analyses of a series of tests for a confined aquifer near Mobile, Alabama were completed prior to an aquifer thermal energy storfor a commed aquier near mobile, Alabama were completed prior to an aquifer thermal energy stor-age experiment. The chemical analyses indicated that there was a potential for clay particle swelling and loss of permeability in the storage aquifer if relatively high quality water was heated and injected. It appears that thermodynamic parameters such as heat capacities and thermal conductivities can be estimated without actually performing measurements. The determination of hydraulic parameters requires the performance of extensive ranteers requires the performance of extensive field testing. Temporary, partially screened observation and pumping wells were installed into the aquifer for the anisotropy test. The series of pump-ing tests emphasized the importance of obtaining good early drawdown data for each of the well tests (Baker IVI) tests. (Baker-IVI) W85-00355

RAINFALL/WATER-TABLE LEVEL RELA-TIONSHIP OF AN UNCONFINED AQUIFER, Hunter District Water Board, Newcastle (Austra-

M. N. Viswanathan. Ground Water, Vol. 21, No. 1, p 49-56, January-February, 1983. 7 Fig, 9 Ref.

Water In Soils—Group 2G

Descriptors: *Aquifer recharge, *Water level, *Rainfall, Infiltration, Unconfined aquifers, Recursive least squares method, Groundwater recharge, Aquifer characteristics.

Aquirer characteristics.

Soil parameters that determine the infiltration rates of a shallow unconfined coastal aquifer due to rainfall were obtained using the recursive least squares method. The parameters were predicted by minimizing the mean square error between the predicted and measured water table levels. The parameters were treated as time dependent variables, and their variation was tracked by introducing a forgetting factor of value 0.98 into the algorithm that predicts the parameters. Forgetting factor curtails the memory of the algorithm, hence, the parameter values depend more on current values of levels and rainfall than on past values. Three sets of soil parameters were used to determine the variation of water table levels. Most of the recharge due to rainfall appears to take place within the first two days of rainfall. After that there is very little variation in the water table level within the list two days of rannal. After that there is very little variation in the water table level due to rainfall, although there is a slight drop in the level on the fourth and fifth day, presumably due to the escape of entrapped air beneath the water table. (Baker-IVI) W85-00359

APPLICATION OF A MICROCOMPUTER IN THE ANALYSIS OF PUMPING TEST DATA IN

CONFINED AQUIFERS,
Water Surveys (Nigeria) Ltd., Bauchi.
For primary bibliographic entry see Field 4B.
W85-00361

2G. Water In Soils

KARST DEVELOPMENT AND THE DISTRIBUTION OF KARST DRAINAGE SYSTEMS IN DEJIANG, GUIZHOU PROVINCE, CHINA, Academia Sinica, Beijing (China). Inst. of Geogra-

phy. L. Song, Y. Zhang, J. Fang, and Z. Gu. Journal of Hydrology, Vol. 61, No. 1-3, p 3-17, February, 1983. 5 Fig. 4 Tab.

Descriptors: *Karst hydrology, *Drainage systems, *China, *Dejiang, *Guizhou Province, Subsurface drainage, Geologic fractures, Groundwat-

The development and distribution of karst and underground drainage systems in the Dejiang Town and Shaqi areas are controlled by geologic structure, lithology, erosive and corrosive base structure, lithology, erosive and corrosive base level, history of geomorphologic evolution, hydrologic conditions and neotectonic movement. Karst features such as valleys, depressions, sinkholes and funnels and the main courses of the subterranean drainage systems are distributed along the regional faults and the axial part of the folds. In the dolomite and dolomitic limestone terranes, underground passages have parrow fissure shapes and ground passages have narrow fissure shapes and surface karst features are rare, but in limestone areas both surface and subsurface features are well developed. After the Cretaceous and especially the neotectonic era, intermittent movements created different levels of surfaces and caves with different different levels of surfaces and caves with different ages, the older situated at higher altitudes. The gradient of underground drainage systems is similar to the slope of the land. Longitudinal profiles underground are convex. Controlled by geologic structure and neotectonic movements, the Naoshuiyan underground system has developed recently more rapidly than the Lengshuiyan system. Thus, the Naoshuiyan system has been capturing the Lengshuiyan system and the subsurface watershed has migrated to the north (Paker-IVI) shed has migrated to the north. (Baker-IVI)

RADIATION AND ENERGETIC EXCHANGES AND THERMAL BALANCE OF THE SOIL IN THE JAMES BAY AREA (LES ECHANGES RA-DIATIFS ET ENERGETIQUES ET LE ILAN THERMIQUE DU SOL EN JAMESIE), B. Singh, R. Taillefer, and J. Poitevin. Canadian Geotechnical Journal, Vol. 21, No. 2, p 223-240, May, 1984. 11 Fig, 6 Tab, 38 Ref.

Descriptors: *Energy, *Radiation, *Soil water, *James Bay, Frost, Seasonal variation, Ground temperature, Temperature effects, Snow cover, temperature, Temperat Soil physical properties.

Detailed and regular measurements of the radiation and energy balances and of the thermal and water regimes of the soil to a depth of 5 m were conducted from August 1979 to August 1980 in an open pine forest near Lake Helene, James Bay. The results derived from these measurements indicate that temperature conditions and thus seasonal frost in the ground are explainable in terms of radiative and heat energy exchanges near the surface, of the physical properties of the soil, of snow accumulation, and of water concentrations and movements in the soil. (Author's abstract) W85-00142

USE OF TEMPE CELL, MODIFIED TO RESTRAIN SWELLING, FOR DETERMINATION OF HYDRAULIC CONDUCTIVITY AND SOIL

WATER CONTENT, Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, G. B. Schaalje, and W.

Canadian Journal of Soil Science, Vol. 64, No. 2, p 265-272, May, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Permeability coefficient, *Soil water content, *Tempe cells, *Swelling, Subsurface drainage, Permeameters, Pore size, Soil types, Soil

Saturated hydraulic conductivity (K) and volumetric soil water content (theta), at different levels of suction, must be known when designing subsurface drainage systems. A pressure cell, called the Tempe cell, modified by others to determine K, was further modified to restrain swelling of the soil Tempe cell, modified by others to determine K, was further modified to restrain swelling of the soil and to facilitate air and water movement across the top and bottom of the sample. This method simulates the lateral and vertical restraints present under field conditions. If swelling is restrained, pore geometry is altered. An apparatus was developed whereby K and theta could be determined for several soil samples concurrently and suction levels could be varied without disturbing the sample. K and theta were determined for several prepared soil samples by the constant head permeameter method and by the Tempe cell with and without swelling restrained, and for soil cores by the Tempe cell with swelling restrained, the K results from the prepared samples did not differ significantly from those of the core samples. For the sandy to silty loam soils at suction levels 0, 10, and 20 kPa, theta of the core sample was less than that from the others at suction levels of 0 and 10 kPa. For all methods, theta was correlated to clay content of the soil. The Tempe cell, as finally modified with swelling restraints can be used to determine K and the soil. The Tempe cell, as finally modified with swelling restraints, can be used to determine K and theta for characterizing the drainability of a non-structured to weakly structured soil, using either prepared samples or cores. (Collier-IVI) W85-00155

EFFECT OF WATER TABLE DEPTH IN OR-GANIC SOIL ON SUBSIDENCE AND SWELL-

Department of Agriculture, Saint-Jean (Quebec).

Department of Agricultus, Research Station. J. A. Millette, and R. S. Broughton. Canadian Journal of Soil Science, Vol. 64, No. 2, p 273-282, May, 1984. 6 Fig. 3 Tab, 22 Ref.

Descriptors: *Water table, *Subsidence, *Swelling, *Organic soils, Density, Oxidation, Drainage, Car-

Organic soil subsidence occurs rapidly after initial drainage and subsequent cultivation. The subsidence process is mainly related to drainage depth, as well as organic soil thickness, bulk density, and other factors. The effects of two water table depths (WTD), 0.6 and 0.9 m below the soil surface, on subsidence, subsidence rate, and swelling of an organic soil were observed in large undis-

turbed cores under greenhouse conditions. Measurements were made in two tiers, 0-0.3 m (top tier) and 0.3 m to WTD (bottom tier) during the growth of a carrot crop with WTD as above, and continued following a rise in the water table. The WTD of 0.9 m caused the top tier to subside twice as much as the same tier in the 0.6 m WTD. Top tier subsidence seemed irreversible in both WTD because minor swelling was observed following a rise in the water table. Most of the reversible subsidence occurred in the bottom tier. Raising the water table reduced the total profile subsidence by 36 and 24% for the 0.6 and 0.9 m WTD, respectively. After correction for oxidation, subsidence 36 and 24% for the 0.6 and 0.9 m WTD, respectively. After correction for oxidation, subsidence accounted for 3.2 and 5.9% of the 0.6- and 0.9-m profiles, respectively. The bulk density increase in the 0.6-m profile before and after the end of the experiment was not significant but a significant increase of 11% was measured in the 0.9-m profile. Subsidence rate decreased in both tiers during the growing period reaching a minimum in both WTD at harvest time. The subsidence rate in the 0.9-m profile at 100 days after seeding was 2.5 times the rate in the 0.6-m profile. (Collier-IVI) W85-00156 W85-00156

QUANTITATIVE EXPRESSION OF FUNC-TION FOR REMOTE INDICATION OF SOIL MOISTURE.

MOISTURE, Akademiya Nauk SSSR, Moscow. Inst. of Evolu-tionary Morphology and Animal Ecology. B. V. Vinogradov. Doklady Biological Sciences, Vol. 272, No. 1-6, p 505-508, September, 1983. I Fig. 4 Ref. Translated from Doklady Akademii Nauk SSSR, Vol. 272, No. 1, p 247-250, September, 1983.

Descriptors: *Soil water, *Remote sensing, *Mathematical equations, Spectral analysis, Luminosity, Water supply development.

The mathematical description of the connection between the coefficient of spectral luminosity and soil moisture is presented. Experimental investigasoil moisture is presented. Experimental investigations on loamy achromatic soil demonstrated the complex nonlinear character of the relation between the coefficient of spectral luminosity (p) in the visible region of the spectrum and the moisture (w) of the 0-2 surface soil horizon. A universal equation was formulated which for the first time yields a quantitative expression of the p(w) dependence over the entire range of soil moisture and reflects the phase state of the moisture in the soil. This makes it possible to extrapolate widely the remote indicators of soil moisture, to minimize the learning sample, and to construct rapid calibration curves of p(w) for the changing natural and technical conditions of a survey. (Baker-IVI) W85-00158

RESISTANCES TO WATER FLOW THROUGH THE SOIL-PLANT SYSTEM.

Soil and Irrigation Research Inst., Pretoria (South Africa)

For primary bibliographic entry see Field 2I. W85-00216

IIIME JUMAIN REFLECTOMETRY: SIMULTANEOUS MEASUREMENT OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY WITH A SINGLE PROBE, Agricultural Research Service, Riverside, CA. Salinity Lab. TIME-DOMAIN REFLECTOMETRY: SIMUL-

For primary bibliographic entry see Field 7B. W85-00220

PROGRAM HVRLV1 - INTERACTIVE DETERMINATION OF HORIZONTAL PERMEABILITIES WITHIN UNIFORM SOILS FROM FIELD TESTS USING HVORSLEV'S FORMULAE.

National Hydrology Research Inst., Calgary (Alberta). Ground Water Div. K. U. Weyer, and W. C. Horwood-Brown. Ground Water, Vol. 20, No. 3, p 289-297, May-June, 1982. 6 Fig, 4 Tab, 1 Ref.

Descriptors: *Permeabil: y coefficient, *Computer models, *HVRLV1, Soil water, Slug tests.

Group 2G-Water In Soils

A computer program is presented for interactive, user oriented calculation of permeabilities from slug tests using Hvorslev's formulae for filters in uniform soil. The analysis acheme is cost efficient and allows for simple sensitivity analyses. The program HVRLV1 applies to field conditions where the well point filter is installed in uniform soil. Three basic methods for permeability determination are considered: the constant head method, the variable head method, and the basic time lag method. Assumptions include: soil at filter intake; infinite depth and directional isotropy; no disturbance, segregation, swelling or consolidation of the soil; no air or gas entrapped in soil, well point or pipe; hydraulic losses in pipes, well point or filter negligible; and no sedimentation or leakage. (Baker-IVI) W85-00312

RELATIONSHIPS BETWEEN SATURATED HYDRAULIC CONDUCTIVITY AND SOME PHYSICAL AND CHEMICAL PROPERTIES, Department of Agriculture, Lethbridge (Alberta).

Jurigation Div.

M. J. Hendry, and B. A. Paterson.

Ground Water, Vo. 20, No. 5, p 604-605, September-October, 1982. 2 Tab, 3 Ref.

Descriptors: *Permeability coefficient, *Soil properties, *Irrigation, Estimating, Permeability, Soil chemistry, Soil physical properties.

Possible relationships between measured saturated hydraulic conductivity and physical and chemical parameters could be found which would aid in estimating the irrigation potential of soil. Physicochemical parameters employed included: depth below ground at which the sample was collected or at which the measurement was made, texture, saturation percentage, bulk density, electrical conductance and the sodium adsorption ratio of the soil. Saturated vertical hydraulic conductivity was measured in the field at 1094 sites using a single ring infiltration method and on 995 undisturbed soil cores in the lab using the constant-head permeameter method. It was concluded that any attempt to use the independent parameters identified in this technical note to estimate either laboratory or field hydraulic conductivity values will likely produce erroneous results. Additional parameters are needed. (Baker-IVI) needed. (Baker-IVI) W85-00339

2H. Lakes

EFFECTS OF BRYOPHYTES ON SUCCESSION FROM ALKALINE MARSH TO SPHAGNUM

BOG, Michiga an State Univ., Hickory Corners. W.K.

Kellogg Biological Station.

J. M. Glime, R. G. Wetzel, and B. J. Kennedy.

The American Midland Naturalist, Vol. 108, No. 2, p 209-223, October, 1982. 3 Fig. 3 Tab, 40 Ref.

Descriptors: *Marshes, *Bogs, *Mosses, *Succession, *Sphagnum, *Lawrence Lake, *Michigan, Marl, Sediments, Bryophytes, Aquatic plants, Cal-

The alkaline eastern marsh of Lawrence Lake, a marl lake in southwestern Michigan, was sampled by randomly placed line transects to determine the bryophyte cover and corresponding vascular plant zones. Cluster analysis indicated three distinct bryophyte zones designated as: Drepanocladus, Campylium/Drepanocladus/Fissidens. These zones correspond with the recognized vascular plant zones cattail/sedge and rose/cattail/sedge, cattail/sedge/Potentilla, and upland Potentilla, respective-ly. Mosses occupied over 50% of the surface in some areas. Initial calcium ion concentration in marsh water used was 99.3 mg/liter. Both green and brown moss portions significantly lowered calcium ion concentration in both light and dark. Specific conductance of marsh water used was 906 micromho/cm. Specific conductance of marsh water used was 906 micromho/cm. Specific conductance of marsh water conductance of marsh water used was 906 micro-mho/cm. Specific conductance of marsh water was lowered significantly following incubation of

mosses. Brown senescent moss portions had significantly less effect on conductance than active green portions, except in Sphagnum. Invasion of Sphagnum, vertical zonation of the mosses on hummocks, zonation with distance from the lake, the abundance of non-Sphagnum moss hummocks, and the ability of the non-Sphagnum species to lower the pH of marsh water during laboratory incubations are evidence that non-Sphagnum mosses facilitate succession from alkaline marsh to Sphagnum bog. (Baker-IVI) mosses. Brown senescent moss portions had signifi-

STUDIES ON LEBANESE STREAMS: THE BI-OLOGICAL ZONATION OF THE NAHR QAB ILIAS (CONTRIBUTION OF THE NATIONAL ASSISTANCE DES COURS D'EAU DU LIBAN: LA ZONATION BIOLOGIQUE DU NAHR QAB ILIAS).

Lebanese Univ., Beirut. Faculty of Sciences N. J. Alouf.

Annales du Limnologie, Vol 19, No. 2, p 121-127, 1983. 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Lebanon, *Nahr Qab Ilias, *Aquatic animals, Invertebrates, Insects, Plecoptera, Diptera, Ephemeroptera, Mountain streams.

Intermittent and permanent parts of the Nahr Qab Ilias, a chalky stream, are studied. Climatological, hydrogeological, hydrographic and biological data are given. The stream is divided into three sectors. Almost all of the fauna of the montaine section is composed of insects which withstand the dryness composed of insects which withstand the dryness of summer by one means or another. The Plecotera dominate the upper part. The annual pattern of flow does not permit other insects to survive. The montaine zone is the refuge of Plecoptera, or any other macroinvertebrates not provided with rivals, except Diptera with rapid growth. The submontaine sector is characterized by the relative stability of the flow throughout the year. Thus colonization by other groups of insects is possible. The Ephemeroptera dominate in the lower part. The division of the hydrographic basin of the Qab Ilias into different sections, as a function of altitude, is commarable, in certain respects to the biological comparable, in certain respects, to the biological zonation observed in Europe. (Moore-IVI)

SULFATE REDUCERS CAN OUTCOMPETE METHANOGENS AT FRESHWATER SULFATE CONCENTRATIONS,

CONCENTRATIONS, Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station. D. R. Lovley, and M. J. Klug. Applied and Environmental Microbiology, Vol. 45, No. 1, p 187-192, January, 1983. 2 Fig, 3 Tab,

Descriptors: *Lake sediments, *Eutrophication, *Bacteria, *Sulfates, Oligotrophic lakes, Methanogens, Anaerobic conditions, Sulfate-reducing bacteria.

Since the inability to adequately sample the most active sulfate reducing zone in eutrophic sediments may have resulted in an underestimate of the abilimay have resurted in an universalisate of the about y of sulfate-reducing bacteria (SRB) to compete with methanogenic bacteria (MB) in freshwater, the interactions between the two populations were investigated in the sediments of an oligotrophic investigated in the sediments of an oligotrophic lake in which the sulfate gradient in the sediments was less steep. Inhibition of sulfate reduction with molybdate stimulated methane production from both hydrogen and acetate. Molybdate did not stimulate methane production in sediments that were preincubated to deplete the sulfate pool. Sulfate reduction accounted for 30 to 81% of the total of terminal metabolism proceeding through sulfate reduction and methane production in Eckman grab samples of surface sediments. The ability of sulfate samples of surface sediments. The ability of sulfate reducers to effectively reducers to effectively compete with methanogens for acetate was related to the sulfate reducers' lower half-saturation constant for acetate metabolism at in situ sulfate concentrations. Processes other than sulfate reduction and methanogenesis consumed hydrogen at elevated hydrogen partial pressures and prevented a kinetic analysis of hydrogen uptake by sulfate reducers and methanogens. The demonstration that sulfate reducers can

successfully compete with methanogens for hydrogen and acetate in sediments at in situ sulfate concentrations of 60 to 105 microM extends the concentrations of 00 to 100 microm extends the known range of sediment habitat in which sulfate reduction can be a dominant terminal process. SRB have the potential to be the dominant acetate and hydrogen consumers in the surface sediments of freshwater lakes. (Baker-IVI)

PRODUCTION AND CONSUMPTION OF HY-DROGEN IN A EUTROPHIC LAKE,

Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).

R. Conrad, M. Aragno, and W. Seiler. Applied and Environmental Microbiology, Vol. 45, No. 2, p 502-510, February, 1983. 6 Fig. 44 Ref.

Descriptors: *Hydrogen, *Eutrophic lakes, *Lake Loclat, *Switzerland, Vertical distribution, Sedi-ments, Lake sediments, Mineralization, Decomposing organic matter, Stratification.

The vertical distribution of hydrogen was measured in the Loclat, a eutrophic and holomictic lake near Neuchatel, Switzerland, before and during summer stratification. Hydrogen concentrations decreased with depth in the anaerobic hypolimnion and were often below the detection limit in the water adjacent to the lake sediment. Highest hydrogen concentrations were noted in the aerobic drogen concentrations were noted in the aerobic water of the epilimnion and metalimnion. The possible role of cyanobacteria and algae for hydrogen sible role of cyanobacteria and algae for hydrogen production is discussed. Aerobic or anaerobic hydrogen consumption activities were noted at all depths of the water column, with highest activities in the hypolimnion. Aerobic hydrogen consumption activity was insensitive to bazide inhibition, but sensitive to heat, mercuric chloride, or cyanide. Aerobic hydrogen-oxidizing bacteria may play a role in the control of hydrogen escaping from particles into the free lake water. Whereas the free water usually contained less than 4 micro l of H/I, much higher hydrogen concentrations may locally arise on particles laree enough to constitute microarise on particles large enough to constitute micro-sites for anaerobic decomposition of organic matter. (Baker-IVI) W85-00104

LIMNOLOGICAL STUDY OF LAKE RANCO (CHILE); MORPHOMETRY, PHYSICS, CHEM-ISTRY AND PLANKTON,

Universidad Austral de Chile, Valdivia. Inst. de

H. Campos, J. Arenas, W. Steffen, C. Roman, and G. Aguero.

Archiv fur Hydrobiologie, Vol. 94, No. 2, p 137-171, July, 1982. 15 Fig, 6 Tab, 35 Ref. Research Fund of the Univ. Austral de Chile grant S-80-23.

*Limnology, *Plankton. Descriptors: *Limnology, *Plankton, *Lake Ranco, *Chile, *Morphometry, Seasonal variation, Stagnation, Oligotrophic lakes, Zooplankton, Mountain lakes, Rainfall, Silica, Nutrients, Snowmelt, Rainfall runoff.

Lake Ranco lies in the pre-Andean mountain range with a surface altitude of 69 m. Ranco is a temper-ate, monomictic, oligotrophic lake with a period of winter circulation and one of summer stagnation. ate, monomictic, oligotrophic lake with a period of winter circulation and one of summer stagnation. The physical and chemical parameters of the lake were studied over one year's cycle. Lake Ranco contains small amounts of orthophosphate and nitrate. The quality and quantity of phytoplankton were analyzed. The physicochemical factors present seasonal fluctuations principally due to high winter pluviosity (2400 mm a year) and to the spring-summer radiation. The amount of silica is high in Lake Ranco, similar to that existing in oligotrophic lakes with hard waters, averaging for the year 11.3 mg/l. The main supply of nutrients seems to come from the influents which are mainly influenced by rains and melted snow. In general, the nutrients in oligotrophic lakes present orthograde distributions. Of the 90 phytoplankton species identified, only seven are periannuals. (Baker-IVI) W85-00108

Lakes-Group 2H

NITROGEN CYCLE OF LAKE VECHTEN (THE NETHERLANDS); ROLE OF SEDIMENTA-

Limnologisch Inst., Nieuwersluis (Netherlands). H. Verdouw, and E. M. J. Dekkers. Archiv fur Hydrobiologie, Vol. 94, No. 2, p 251-263, July, 1982. 3 Fig. 6 Tab, 17 Ref.

Descriptors: *Nitrogen cycle, *Sedimentation, *Lake Vechten, *Netherlands, Particulate matter, Nitrogen, Transport, Seasonal variation, Stratifica-

Sedimentation was measured in Lake Vechten during three year cycles to evaluate the role of downward transport of particulate matter in the nitrogen cycle. Besides seasonal patterns, horizontal and vertical variations in sedimentation were measured, revealing a funnel effect together with transport of particulate material along the lake's edge. The total nitrogen sedimentation at 8 m depth during the stratification period was calculated using correction factors for the edge effect caused by the consequent transport of particulate material along the lake bottom. The greatest rate of sedimentation occurred during spring and autumn, lowest during the winter. Average sedimentation rates during the stratification period also differed considerably in different years. Sedimentation of particulate material appeared to be an imdiffered considerably in different years. Sedimentation of particulate material appeared to be an important element in the nitrogen cycle of the lake, as the amount of nitrogen sedimenting through the 8 m plane during stratification roughly equalled the total nitrogen content of the overlying water layers. (Baker-IVI)

CONTEMPORARY SEDIMENTARY ENVI-RONMENTS ON BAFFIN ISLAND, N.W.T., CANADA: RECONNAISSANCE OF LAKES ON CUMBERLAND PENINSULA, Queen's Univ., Kingston (Ontario). Dept. of Geog-

Queen's Univ., Kingston (Ontario). Dept. of Geography.
R. Gilbert, and M. Church.
Arctic and Alpine Research, Vol. 15, No. 3, p 321332, August, 1983. 8 Fig., 2 Tab, 33 Ref. Canadian
Dept. of Energy, Mines and Resources grant EMR
4-227/76.

Descriptors: *Glacial sediments, *Lake sediments, *Baffin Island, *Northwest Territories, Zooplankton, Cumberland Peninsula, Limnology, Varves, Iron, Redox conditions, Seasonal variation.

Studies were made of four lakes receiving signifi-cant quantities of glacial sediment and of five lakes receiving no glacial sediment. All waters contain less than 10 mg/l dissolved sediment, with highest values in the glacial lakes where ion scavenging can occur from fine suspended sediment. Zoo-plankton abundance and total carbon content of sediments are an order of magnitude higher in the nonglacial lakes. Shallow box cores were taken in nonglacial lakes. Shallow box cores were taken in order to study the recent sediments. Two distinct sedimentary environments are represented in the lake sediments: one dominated by higher energy, largely physical processes such as turbdity current flow, and another where chemical processes governed principally by oxidation/reduction conditions prevail. In the former, which occurs in both glacial and nonglacial lakes, periodic high sediment inflow associated with glacial or nival melt, or with summer precipitation, produces distinct laminae. The coarse laminae were supposedly deposited from the inflowing glacial streams which continued through the lake intermittently as underflows or possibly interflows. Although they contain less than 10% sand, grading and load structures indicate that these beds were probably deposited from underflows or interflows in the lake. Iron bands containing up to 39% by weight iron form where sedimentation occurs slowly and continuously under redox conditions which change as deposition occurs. Despite a very pronounced difously unter recox conducts which change as deposition occurs. Despite a very pronounced dif-ference between winter and summer inflow to the lakes, varves could not be recognized in any of the sediments. (Baker-IVI) W85-00110

USE OF WATER BOATMEN (CORIXIDAE) IN THE CLASSIFICATION OF LAKES,

Crewe and Alsager Coll. of Higher Education, Alsager (England). A. A. Savage. Biological Conservation, Vol. 23, No. 1, p 55-70, May, 1982. 8 Fig, 26 Ref.

Descriptors: *Lake classification, *Invertebrates, *Corixidae, *Scotland, *England, *Wales, Conservation, Conductivity, Distribution.

Data on populations of Corixidae in 55 water bodies in England, Scotland and Wales, are considered. There is a significant correlation between the distribution of each of six species of Corixidae and the conductivity of water bodies. Two species, S. scotti and S. concinna, are confined to waters of low and high conductivity respectively. S. falleni and C. praeusta tend to occur in water bodies of intermediate size and high conductivity; the former being more numerous. S. distincta occurs in ponds and lakes of relatively low conductivity but is replaced by S. scotti at very low conductivity. S. dorsalis is found at all but the lowest conductivities but tends to be replaced by S. falleni in water bodies of high conductivity and intermediate size. The comparisons of the relative numbers of the six species give an indication of the biological differences between a series of water bodies and therefore may be useful in planning programs of conserfore may be useful in planning programs of conservation. (Baker-IVI) W85-00119

ECOLOGICAL SURVEY OF STANDING WATERS IN NORTH WEST AFRICA: II. SITE DESCRIPTIONS FOR TUNISIA AND ALGE-

Station Biologique de la Tour du Valat, Arles

N. C. Morgan. Biological Conservation, Vol. 24, No. 2, p 83-113, October, 1982. 2 Tab, 29 Ref.

Descriptors: *Standing waters, *Wetlands, *Ecology, *Tunisia, *Algeria, North West Africa, Lakes, Oases, Chotts, Sebkhets. Invertebrates, Waterfowl,

Outline ecological descriptions are given for 39 standing water sites visited in Tunisia from 5-20 May 1976 and Algeria, north of the Sahara, from 18 January to 3 February 1977. The study incorporates physical data, aquatic vegetation, invertebrates and waterfowl. An assessment is made of the conservation value of each site. The sites were chosen to provide a range of major standing water types from permanent freshwater to temporary saline chotts. Sites were primarily of a Mediterra-nean climate. The chotts consisted of a series of nean climate. The chotts consisted or a series or large shallow depressions stretching east-west along the northern extremity of the Sahara which were lakes during the Pleistocene pluvials and in some cases are below sea level. The unvegetated sebkhets lie to the north of the arid zone of the chotts where the ratio expropring precipitation. chotts, where the ratio evaporation:precipitation ranged from 2.3 to 4.2 for the sites sampled. They ranged from 2.3 to 4.2 for the sites sampled. They form shallow pans with clay/silt bottom and are seasonal with eu-hyperhaline water conditions. The distribution of the vegetated sebkhets is similar to that of the unvegetated sebkhets, being very shallow, seldom exceeding I m in water depth, and having a clay/silt and/or sandy substrate. Sites also included oases, freshwater mountain lakes, oligohaline lowland lakes, and shallow lakes. (Baker-IVI)

ECOLOGICAL SURVEY OF STANDING WATERS IN NORTH WEST AFRICA: III. SITE DESCRIPTIONS FOR MOROCCO, Station Biologique de la Tour du Valat, Arles

(France). N. C. Morgan. Biological Conservation, Vol. 24, No. 3, p 161-182, November, 1982. 1 Tab, 20 Ref.

Descriptors: *Standing waters, *Morocco, *Ecology, Aquatic plants, Invertebrates, Conservation, Waterfowl, Sebkhets, Lakes, Mountain lakes, Marshes, Wetlands, Marine wetlands, Seasonal variation, Salinity.

Outline ecological descriptions are given for 24 standing waters in Morocco incorporating physical data, aquatic vegetation, invertebrates, and watercasis, aquatic vegetation, invertebrates, and water-fowl. An assessment is made of the conservation value of each site. The vegetated sebkhets com-prise a group of shallow mixohaline waterbodies in which the salinity may range higher for short which the sammy may range nigher for short periods in the summer prior to seasonally drying out. They have clay silt or sandy bottoms and the salinity is low enough to allow the growth of several macrophyte species. Seasonal mesohaline wetlands dry out in the summer and showed simi-lar physical and biological characteristics. They resemble some of the vegetated sebkhets in being coastal, and separated from the sea by a dune system. The principal source of water is the winter flooding of oueds, and they are thus fed by fresher er and less saline in character. The freshwater ntain lakes are all high altitude lakes above 1000 m of moderate size up to 250 ha. They are generally considerably deeper than the other water bodies sampled, up to a maximum of 100 m, and are fed by impermanent rivers and/or groundwat-er. The water is fresh, highly calcareous and perer. The water is tream, ingruy calcarcous and per-manent and the average ratio annual evaporation/ rainfall does not exceed 1.5. The littoral substrate is variable but stones were present in eight of these sites, whereas they were only found in four others. Also sampled were seasonal marshes, and marine wetlands. (Baker-IVI) W85-00123

RESPONSE OF FISHES TO PERIODIC SPRING FLOODS IN A SOUTHEASTERN STREAM,

University of Southern Mississippi, Hattiesburg. Dept. of Biology.
S. T. Ross, and J. A. Baker.
American Midland Naturalist, Vol. 109, No. 1, p 1-14, January, 1983. 6 Fig, 1 Tab, 44 Ref.

Descriptors: *Fish behavior, *Floodplains, *Floods, Population dynamics, Species diversity, Seasonal variation, Diurnal variation, Turbidity.

Periodic flooding is characteristic of most lotic systems. Nondestructive floods occur in low gradi-ent systems in which floods are characterized by systems. Nondestructive floods occur in low gradient systems in which floods are characterized by lateral expansion rather than increases in depth. Natural fringing floodplains may be seasonally inundated. Movement of fishes onto a fringing floodplain was studied by seining and trapping during five spring floods. The wenty-six species of fish were collected from the inundated foodplain. The known channel fauna is 42 species. Species numerically dominant on the floodplain were Fundulus olivaceus, F. notti, Gambusia affinis, Notropis welaka, N. texanus, N. roseipinnis, Leponis macrochirus, L. cyanellus and L. marginatus. The number of fish taken per try was generally the greatest on the upper floodplain during the day and greatest nearer the channel at night. Night activity of fishes on the floodplain was apparently low. Several species were common in the channel but did not exploit the floodplain. Activity of P. nigrofasciata was negatively correlated with floodinduced turbidity. A flood-exploitative species, Notropis texanus, had higher population abundance during 3 high-flow years than in 3 low-flow years, suggesting that the flish in Black Creek may be controlled in part through structural habitat suitability and in part through structural habitat suitability and in part through stochastic events such as the intensity of spring flooding. It is apparent that each species responds differently to these factors. (Baker-IVI) W85-00130

INTEGRATION OF FOREST AND LAKE FER-TILIZATION: TRANSPORT AND TRANSFOR-MATIONS OF FERTILIZER ELEMENTS,

British Columbia Ministry of Environment, Van-couver. Fish and Wildlife Branch. For primary bibliographic entry see Field 5G. W85-00147

DISTRIBUTIONS OF FERROUS IRON AND SULFIDE IN AN ANOXIC HYPOLIMNION,

Field 2-WATER CYCLE

Group 2H-Lakes

Lamont-Doherty Geological Observatory, Palisades, NY.

R. B. Cook

Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 2, p 286-293, February, 1984. 3 Fig. 4 Tab, 53 Ref. NSF grants OCE-78-20898, DAR-79-17291 and DEB-80-17639.

Descriptors: "Hypolimnion, "Ferrous iron, "Sulfides, "Diagenesis, "Experimental Lakes Area, "Ontario, Sediment-water interfaces, Interstital water, Iron, Lake sediments, Eutrophic lakes, An-

Equilibrium processes control the Fe(2+) and sigma-H2S concentrations in the water column and pore water of an anoxic hypolimnion. Measurements of the solid phase chemistry of the sediments may determine if the species predicted to have been formed on the basis of equilibria were actually present and may verify diagenetic changes. In 1979, water samples were collected from over the tensest reach of the agreementally autopakied lake 1979, water samples were collected from over the deepest part of an experimentally eutrophied lake, Lake 227 of the Experimental Lakes Area near Kenora, Ontario. In the anoxic hypolimnion, sigma-H2S exhibits a mid-depth maximum (15-22 micro mol/1, summer) while Fe(2+) increases with depth (650 micro mol/1, summer; 200 micro mol/1, winter). At the mid-depth sigma-H2S maximum and below, saturation with respect to amorphous FeS is reached, and the concentration of sigma-H2S is limited by the high Fe(2+) concentrations. FeS is reached, and the concentration of sigma-H2S is limited by the high Fe(2+) concentrations, in accord with the FeS solubility product. Values for pKsp (solubility product constant) for FeS determined from the sigma-H2S maximum and below averaged 3.16 in 1979. Sediment pore water samples were taken in the top 10 cm of sediment; pore water sigma-H2S and Fe(2+) are in equilibri-um with amorphous FeS. Analyses of sediment sample cores confirms the existence of an iron sulfide phase. Fe(2+) increases to concentrations at which siderite may form, although the presence of siderite has not been verified. In the anoxic hypolimnion about 90% of the observed flux origi-nates at the sediment-water interface, while the remainder is derived from pore water flux. (Col-lier-IVI) lier-IVI) W85-00149

CONTRIBUTION OF PARTICULATE PHOS-PHORUS (> 250 MICRO M) TO THE TOTAL PHOSPHORUS POOL IN LAKE WATER,

Alberta Univ., Edmonton. Dept. of Zoology. E. E. Prepas, and J. Vickery.

Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 2, p 351-363, February, 1984. 7 Fig. 1 Tab, 23 Ref, 3 Append.

Descriptors: *Alberta, *Phosphorus, *Lakes, *Particle size, Cycling nutrients, Euphotic zone, Productivity, Chlorophyll, Epilimnion, Hypolimnion, Thermal stratification, Mixing.

Previous studies have presented conflicting data on the importance of large particles to the total phos-phorus pool of lakes. Particulate phosphorus (PP) > 250 micro m was concentrated in the euphotic zone of 17 lakes studied over a three year period in central Alberta. When the euphotic zone extended below the epilinnion, PP > 250 micro m was concentrated deep in the euphotic zone. PP > 250 micro m was a significant but variable portion of the total phosphorus (TP) pool in individual lakes. The contribution of this fraction varied among The contribution of this fraction varied among lakes: average summer values for the euphotic zone range from 3 to 19%. Among lakes, the contribution of large particles to the TP pool decreased proportionally as lake productivity (estimated by chlorophyll a (Chl-a)) increased. The relative contribution of PP > 250 micro m in summer accounted for a significant portion of the residual variation in the spring TP-summer Chl-a relationship but not the summer TP-summer Chl-a relationship in the study lakes. These apparently contradictory results can be explained by differences between lakes that mixed intermittently throughout the summer and those that remained permanently thermally stratified during this time. (Collier-IVI) W85-00151

EMPIRICAL PREDICTION OF CRUSTACEAN ZOOPLANKTON BIOMASS AND PROFUNDAL MACROBENTHOS BIOMASS IN LAKES, McGill Univ., Montreal (Quebec). Dept. of Biol-

ogy. J. M. Hanson, and R. H. Peters.

Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 3, p 439-445, March, 1984. 2 Fig, 4

Descriptors: *Biomass, *Lakes, *Productivity, *Macrobenthos, *Zooplankton, Chlorophyll a, Littoral zone, Phosphorous, Crustaceans, Nutrients, Benthos, Lake morphometry.

Changing nutrient levels and other factors are related to lake biomass and productivity. Data on 33 North American, 14 European, and two African lakes was taken from the literature to develop and compare several estimators of crustacean zooplankton biomass and profundal macrobenthos biomass. Parameters utilized were mean total phosphorus concentration, mean chlorophyll-a concentration, Secci depth, mean depth, maximum depth, lake surface area, mean crustacean zooplankton biomass, and mean profundal macrobenthos biomass. Both mean zooplankton biomass and mean profundal macrobenthos biomass correlated better with mean total phosphorus concentration than profundal macrobenthos biomass correlated better with mean total phosphorus concentration than with Secchi depth, mean depth, maximum depth, or lake surface area. Mean total phosphorus concentration was also superior to mean chlorphyll-a concentration as an estimator of zooplankton biomass, but data were insufficient to evaluate chlorophyll-a concentration as an estimate of macrobenthos biomass. Inclusion of maximum depth as a variable in a multiple regression resulted in a slight but significant improvement in the zooplanktonvariable in a margin eigenvalue and a significant improvement in the zooplankton total phosphorus relationship. Inclusion of lake surface area as a variable in a multiple regression significantly improved the predictive power of the profundal macrobenthos - total phosphorus rela-tionship. Correlations of littoral zone production to lake nutrient levels or morphometry can not be attempted due to a scarcity of data. (Collier-IVI) W85-00152

PREDICTION OF CHLOROPHYLL A CON-CENTRATIONS IN FLORIDA LAKES: IMPOR-TANCE OF AQUATIC MACROPHYTES, Florida Univ., Gainesville. Center

Weeds

weeds.
D. E. Canfield, Jr., J. V. Shireman, D. E. Colle,
W. T. Haller, and C. E. Watkins, II.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 3, p 497-501, March, 1984. 2 Fig, 3
Tab, 17 Ref. EPA grant R-905497.

Descriptors: *Chlorophyll a, *Macrophytes, *Florida, *Lake Pearl, Nitrogen, Phosphorus, Trophic level, Phytoplankton, Aquatic weed control, Eutrophic lakes, Nutrients.

Submersed aquatic macrophytes can inhibit the development of phytoplankton and thus may be an important source of the variability in nutrient-chlorophyll regressions which are an accepted tool for estimating the response of lakes to changes in nutrient load rates. Chlorophyll a concentrations in Lake Pearl, Florida, increased as the percentage of the lake's total volume infested with aquatic macrophytes decreased. Using data from 32 Florida lakes, predictions of chlorophyll a concentrations were improved by including a term for the perwere improved by including a term for the per-centage of the lake's total volume infested with centage of the lake's total volume intested with macrophytes in existing nutrient-chlorophyll models. The best-fit multivariate regression equation was (log CHLA = 1.02 log TN + 0.28 log TP -0.005 PVI - 2.08), where CHLA is the chlorophyll a concentration (mg/cu m), TN is the total N concentration (mg/cu m), TP is the total P concentration (mg/cu m) and PVI is the percentage of the lake's total volume infested with macrophytes; this equation assesses the potential effect of aquatic macrophytes on chlorophyll yields and Secchi disc transparencies in lakes of different trophic status. Chlorophyll concentrations in Lake Pearl aver-Chiorophyli concentrations in Lake Pearl aver-aged 12 mg/cu m during a monitoring period; predicted CHLA averaged 9 mg/cu m and were not significantly different from the measured aver-age. The amount of variance in CHLA explained by including a PVA term will depend on the lakes included in the data set; other factors such as zooplankton grazing, nonalgal turbidity, and hydraulic flushing rates may be more important for determining CHLA in some lakes. Aquatic weed control measures may impact CHLA. (Collier-IVI) W85-00154

SEASONAL VARIATIONS OF DOMINANT PHYTOPLANKTON, CHLOROPHYLL A AND NUTRIENT LEVELS IN THE PELAGIC REGIONS OF LAKE BIWA,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological

V. Tezuka.

Japanese Journal of Limnology, Vol. 45, No. 1, p 26-37, January, 1984. 11 Fig. 1 Tab, 37 Ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Chlorophyll a, *Nutrients, *Lake Biwa, *Japan, Transparency, Nitrates, Nitrogen, Phosphorus, Trophic levels, Eutrophication.

In order to clarify the present trophic status of Lake Biwa, the largest, monomictic lake in Japan, seasonal variations of dominant phytoplankton, chlorophyll a and nutrient levels were surveyed for offshore waters of its north (main) and south (subsidiary) basins from February to December 1981. Thermal stratification began to develop in April and was well established in mid summer, almost lacking an epilimnion. Practical destratification began to occur in September, and thereafter the depth of the epilimnion increased toward December. Surface water temperature in the south basin followed a similar seasonal pattern to that of the surface water temperature in the north basin, but it was somewhat lower than that of the north basin in the coldest month. Secchi disc transparency of the north basin was high in winter, low in spring and autumn, and intermediate in summer; I was low in the south basin throughout the year. Species composition of dominant phytoplankters in the surface water was rather similar in both basins. For all water samples collected from both basins. the surface water was rather similar in both basins, dissolved inorganic phosphorus was below the limit of detection. Total phosphorus concentrations were low in the summer. The annual mean concentration of total phosphorus in the surface water was higher in the south basin than in the north basin. Concentrations of ammonium nitrogen were low compared with nirate plus nitrite nitrogen. Nitrate plus nitrite nitrogen was detected in high concentrations except for three months from August to October in the surface layer of the north basin and the whole layer of the south basin. (Baker-IVI) (Baker-IVI) W85-00188

PARTITIONING OF HEAVY METALS INTO MINERAL AND ORGANIC FRACTIONS IN SEDIMENTS FROM A RESERVOIR, Central Research Inst. of Electric Power Industry,

Tokyo (Japan). M. Sakata.

Japanese Journal of Limnology, Vol. 45, No. 1, p 38-43, January, 1984. 2 Fig, 16 Ref.

Descriptors: *Reservoirs, *Sediments, *Japan, *Heavy metals, Minerals, Manganese, Iron, Zinc, Cadmium, Copper, Nickel, Leaching, Sediment size Storm runoff

A sediment core was collected from S Reservoir, A sediment core was collected from S Reservoir, located in the western part of Okayama Prefecture, Japan. Water depth at the sampling station was 82 m. Selective chemical leaching of the core sediment samples enabled the vertical distribution of six heavy metals (Fe, Mn, Zn, Ni, Cu, and Cd) to be determined. The heavy metal content of the core is relatively high in small grain layers. The variations of fine particle percentage and also heavy metal content in the sediment core may be attributed to the occurrence of storms with heavy ited to the occurrence of storms with heavy attributed to the occurrence of storms with heavy rainfall which carries larger sizes of sediments. The majority of the Mn and Cd is contained in the NH2OH-HCl soluble fraction (mostly iron and manganese oxide and hydroxide coatings on sili-cate minerals), whereas more than 50% of the Fe, Zn, Ni, and Cu is present in the HF soluble frac-tion (silicate lattice). Only manganese is significant-

Lakes-Group 2H

ly enriched in the NH2OH-HCl soluble fraction of the settling material collected by the sediment trap near the bottom, probably due to the release of manganese from bottom sediment into overlying water. Manganese oxide and hydroxide reprecipi-tated under oxic conditions of the bottom water after the release might have been effectively col-lected by the sediment trap. (Baker-IVI)

SEASONAL FLUCTUATION IN THE NUMBER OF AEROBIC HETEROTROPHIC BACTERIA AND ITS RELATION TO ENVIRONMENTAL FACTORS IN THE UPSTREAM AREA OF THE TAMAGAWA RIVER (IN JAPANESE),

JAMAGAWA RIVER (IN JAPANESE), Tokyo Univ. of Agriculture and Technology (Japan). Lab. of Biology. K. Morikawa. Japanese Journal of Limnology, Vol. 45, No. 1, p 69-78, January, 1984. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Seasonal variation, *Rivers, *Bacteria, *Tamagawa River, *Japan, Chlorophyll, Acidity, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Nitrates, Nitrogen, Phaeophytin.

trogen, Phaeophytin.

Seasonal variations in water temperature, pH, dissolved oxygen, BOD, COD, NO3-N, discharge, amount of chlorophyll a plus phaeophytin, and the number of aerobic heterotrophic bacteria in water were determined in an upstream area of the Tamagawa River in Tokyo, Japan. The number of bacteria in water fluctuated between 3000 and 14000 cells/cu cm. Generally, they were numerous when the discharge was small and vice versa. During flood stage, in spite of huge flow, the bacteria number was large. The periphyton of the river bed exfoliated when the discharge was large, and the amount of chlorophyll a plus phaeophytin a did not increae over 100 mg/sq m. The number of bacteria in periphyton and the amount of chlorophyll a plus phaeophytin a have a high correlation coefficient. The percentage of pigment producing bacteria rose with the increase of chlorophyll a plus phaeophytin a, suggesting a bacterial community relating to the epiphytic algae. After exfoliation of periphyton, the number of bacteria did not decrease as much as the amount of chlorophyll a plus phaeophytin a, suggesting another bacterial community not depending on them. No correlation was noted between the number of bacteria in water and that in periphyton. (Baker-IVI) W85-00193

NITROGEN BUDGET OF A SUBARCTIC STREAM ALTERED BY BEAVER (CASTOR CANADENSIS),

Woods Hole Oceanographic Institution, MA. R. J. Naiman, and J. M. Melillo. Oecologia, Vol. 62, No. 2, p 150-155, May, 1984. 3 Fig. 2 Tab, 36 Ref. NSF grant DEB 81-05677.

Descriptors: *Beavers, *Nitrogen, *Nutrient budget, *Beaver Creek, *Quebec, Nitrogen fixation, Ecosystems, Beaver dams, Sediments, Cycling nutrients, Microorganisms, Precipitation, Throughfall, Subarctic streams.

Beaver (Castor canadensis) affect the structure and dynamics of stream ecosystems by transferring or-ganic matter from the terrestrial to the aquatic ganic matter from the terrestrial to the aquatic system and by building dams. To quantify their influence, measured rates of nitrogen dynamics were used to construct a nitrogen budget for a section of a second order stream (Beaver Creek) in eastern Quebec and a beaver dam in that stream. The budget demonstrates the importance of sedi-ment accumulations and an expanded wetted area to the annual nitrogen economy and to pathways of nitrogen cycling. Major changes after impound-ment (per unit area) include a reduction in al-lochthonous nitrogen and an increase in nitrogen ment (per unit area) include a reduction in al-lochthonous nitrogen and an increase in nitrogen fixation by sediment microbes. In riffles, 83.3% of the annual nitrogen inputs (7.2 g N/sq m) are accounted for by direct allochthonous inputs (56.9%) or as lateral inputs form the forest floor (26.4%). In the beaver pond, most of the annual input (7.7 g N/sq m) is accounted for by nitrogen fixation associated with accumulated sediment fixation associated with accumulated sediment (66.2%); direct allochthonous inputs have been

reduced to 22.1% and lateral inputs to 1.3% of the budget. Precipitation contributes 9.1%, but throughfall and nitrogen fixation associated with wood are negligible. The turnover time for nitrogen is a slow 72.4 yr. Overall, the beaver-modified gen is a stow 12.4 yr. Overast, the beaver-modified section accumulated about 1000 times more nitro-gen than before alteration. The ecosystem implica-tions of beaver activity suggest that current con-cepts of patterns and processes in running waters require modification. (Moore-IVI) W85-00209

STRUCTURE OF BENTHOFAUNA AGGREGA-TIONS IN THE LOTIC ENVIRONMENT OF THE RIVER WEL, MAZURIAN LAKE DIS-

TRICT,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow
(Poland). Inst. of Hydrobiolgy and Water Conser-

vation. S. Wielgosz. Acta Hydrobiologica, Vol. 23, No. 4, p 349-361, 1981. 3 Fig. 5 Tab, 20 Ref.

Descriptors: *Benthic fauna, *Lotic environment, *Poland, *River Wel, Mazurian Lakes, Zoobenthos, Population dynamics, Species diversity,

In structure of zoobenthos aggregations in the longitudinal profile of the River Wel was investigated and 63 taxons were identified. Among the identified taxons, 27 forms and morphological groups of Chironomidae, Odontomesa fulva, and Paratrissocladius excerptus were found for the first time in the the Mazurian Lake district. They are rarely found in Polish inland waters. The location of various species suggests considerable differentiation of lotic environments in the River Wel. Differentiation of lotic environments in the River Wel. Differentiation of the taxons at various locations made it possible to classify the stations in the epipothammon zone. On the basis of variability indices the degree of water degradation was evaluated. Fluctuations in numbers and biomass of the benthofauna were described. Young cohorts of Glyptotendipes spp. drifting from the lake had a marked influence on the density of zoobenthos in the river. (Baker-IVI)

FACTORS AFFECTING ALKALINE PHOS-PHATASE ACTIVITY IN A LAKE (SHORT-TERMS EXPERIMENTS), Warsaw Univ. (Poland). Dept. of Environmental

Warsaw Ontv. (Foliand). Dept. of Environmental Microbiology. W. Siuda, R. J. Chrost, R. Weislo, and M. Krupka. Acta Hydrobiologica, Vol. 24, No. 1, p 3-20, 1982. 4 Fig. 4 Tab, 35 Ref.

Descriptors: *Lakes, *Plankton, *Alkaline phosphatase, Eutrophication, Enzymes, Stagnation, Seasonal variations, Diurnal distribution, Phytoplankton, Bacteria.

The dynamics of alkaline phosphatase activity of plankton in the epilimnion of eutrophic lakes for a day and night cycle during summer stagnation were investigated. Environmental factors which might influence enzymatic hydrolysis of organic phosphorus compounds were studied as well. A great range of variations of physicochemical and biological parameters was discovered during 24 hr when measuring these parameters in 4 hr intervals. The results indicate the existence of complex and subtle mechanisms of circulation and transformation of phosphorus in the waters between algae. tion of phosphorus in the waters between algae, environment, and bacteria. A number of factors environment, and bacteria. A number of factors influencing circulation of phosphorus in the epilimnion undergo significant changes and fluctuations in a day-and-night cycle. The realization of the range of these variations is very useful in helping to estimate the dynamics of seasonal or annual variations. (Baker-IVI)
W85-00226

EFFECT OF WASTE WATER ON CILIATE COMMUNITIES IN THE BIALA PRZEMSZA

RIVER, Jagiellonian Univ., Krakow (Poland). Inst. of Environmental Biology.

Acta Hydrobiologia, Vol. 24, No. 1, p 29-37, 1982. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Rivers, *Bioindicators, *Water pol-lution effects, *Ciliates, *Biala Przemsza River, *Poland, Industrial wastes, Municipal wastes, Heavy metals, Sulfates.

The Biala Przemsza River is polluted by both municipal and industrial waste waters which also include the salts of heavy metals and sulfates. Two communities containing diverse species of ciliates were identified according to their pollution levels. The common most important species in the biocenosis occurred both in cold and warm seasons, having that the transfer the more than 100 more than osis occurred both in cold and warm seasons, showing that water temperature is not an important factor in population diversity. In the ciliate communities the microphagous ciliates were predominant. Algivorous species were found only where the pollution was decreasing owning to the river's self-purification process. The quality of water was classified as polysaprobic or beta-mezo-saprobic according to the location. The ability of some species to serve as pollution level indicators was discussed. (Baker-IVI)

GROUPS OF PELAGIC ZOOPLANKTON IN THREE LAKES OF DIFFERENT TROPHY,

Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology. C. Kowalczyk, and S. Radwan. Acta Hydrobiologia, Vol. 24, No. 1, p 39-51, 1982. 2 Fig. 2 Tab, 27 Ref.

Descriptors: *Zooplankton, *Trophic levels, *Bikcze Lake, *Brzeziczno Lake, *Piaseczno Lake, *Poland, Bioindicators, Cladocera, Rotatoria, Species composition.

In the material collected from three lakes of the In the material collected from three lakes of the Leczna - Wiodawa, Lakeland: Bikcze, Brzeziczno, and Piaseczno, 42 species and forms of Rotatoria, 12 species of Cladocera, and 8 species of Copepoda were found. The predominating species indicate clearly the differentiation of those lakes, especially in the Rotatoria and Cladocera groups. Indicators of ecological importance were calculated on the basis of which characteristic species composition was found for the investigated lakes. For lakes flikeze and Brzeziczno the species composition was found for the investigated lakes. For lakes Bikcze and Brzeziczno the species composition consisted of 4 species (Keratella cochlearis, Bosmina coregoni, Eudiaptomus graciloides and Polyarthra vulgaris) and for lake Piaseczno, 5 species were identified (Keratella cochlearis, Conochilus unicornis, Daphnia hyalina, Bosmina coregoni and Eudiaptomus graciloides). The most essential differences between the lakes occurred in the Cladocera group, then in the Rotatoria group. Keratella cochlearis, a species of great ecological valence, shows a high value as an indicator in each investigated lake reaching its highest potential in Lake Piaseczno. (Baker-IVI)

ZONATION OF MAYFLIES (EPHEMEROP-TERA) IN SEVERAL STREAMS OF THE TATRA MTS AND THE PODHALE REGION, Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych. M. Olechowska.

Acta Hydrobiologia, Vol. 24, No. 1, p 63-71, 1982. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Mayflies, *Tatra Mountains, *Pod-hale region, *Poland, *Zonation, Larvae, Moun-tain streams, Seasonal variation, Altitude.

The zonation of mayfly larvae was investigated in four large streams of the Podhale region: Czarny Dunajec, Bialka, Rogoznik and Bystry. Preliminary observation were carried out on the zonation of mayflies in the Waksmundzki stream (High Tatra Mountains)and in the the streams Pysznianski and Koscieliski (Western Tatra Mountains). In podhale streams, larval communities are unaffected by polution and correspond to zones 1-3 of settlement. In the high-mountain stream Waksmundzki (characterized by difficult environmental conditions) only four species were found. In this

Group 2H-Lakes

stream mayfly larvae were found only up to an altitude of 1400 m. Their absence above 1400 m may be due to the great seasonal variation in water yield in the upper part of the valley. (Moore-IVI) W85-00229

RECENT TROPHIC CHANGES IN KOOTENAY LAKE, BRITISH COLUMBIA, AS RECORDED BY FOSSIL DIATOMS,

BY FOSSIL DIATOMS, Department of Fisheries and Oceans, Vancouver (British Columbia). Field Services Branch. G. L. Ennis, T. G. Northcote, and J. G. Stockner. Canadian Journal of Botany, Vol. 61, No. 7, p 1983-1992, July, 1983. 6 Fig. 2 Tab, 50 Ref.

Descriptors: *Diatoms, *Kootenay Lake, *British Columbia, *Trophic level, Fossils, Eutrophication, Fertilizers, Industrial wastes, Phosphorus, Sedimentation rate, Species diversity, River regulation, Nutrients, Turbidity.

Short sediment cores (ca. 40 cm long) were collected from three locations within Kootenay Lake, B.C., and the occurrence of diatoms within the cores was recorded and analyzed. This analysis of fossil diatoms in the sediments of Kootenay Lake has provided evidence for environmental change as a result of man's activities in the drainage basin. inges to the trophic status of the lake are relat-Changes to the trophic status of the lake are relatived to operation of a phosphate fertilizer plant (beginning in 1953) on the major southern inlet river and to more recent water regulation on both the southern and northern major inlet rivers. Diatom numbers and volumes at the deeper core depths were lowest. Diatom species in the deeper core depths consisted of an assemblage of oliogotrophic and eutrophic indicators corresponding to high (but not critically high) phosphorus loading to the lake. Above the 5-cm depth, numbers increased and neaked at the 3-cm depth in samples to the lake. Above the 5-cm depth, numbers in-creased and peaked at the 3-cm depth in samples nearest the south end of the lake. At other loca-tions within the lake, where sedimentation rates were lower, numbers peaked in the top centimeter of sediment. Concomitant with increased phospho-rus loading diatom species indicative of oligotro-phic conditions such as Cyclotella coellata de-clined, while eutrophic indicators including Cyclo-tella clonerats. Melosing examilata va annusticisma cimed, while eutrophic indicators including Cyclo-tella glomerata. Melosira granulata v. angustissima, Stephanodiscus spp., Asterionella formosa, and Fragilaria crotonensis increased. Asterionella for-mosa and Fragilaria crotonensis showed highest abundances in the top 2 cm of the core. These mosa and Fraginaria crotonensis snowed nignesis abundances in the top 2 cm of the core. These species, which form a major component of the spring and fall diatom blooms, were responding to both increased nutrients and improved light conditions resulting from decreased freshet turbidity. tions resulting from decreased freater unrounty. The Araphidineae/Centrales ratio was not useful in classifying trophic changes in Kootenay Lake since numbers of centric diatoms did not decline with nutrient enrichments (although there was a dominance shift from oligotrophic centrics to eutrophic centrics). Shannon-Wiener diversity values remained high throughout the recent history of the remained high throughout the recent history of the lake. (Author's abstract)

IDENTIFICATION OF PHOTOSYNTHESIS-LIGHT MODELS FOR AQUATIC SYSTEMS; I. THEORY AND SIMULATIONS,
Virginia Univ., Charlottesville. Dept. of Environ-

ental Sciences.

B. J. Cosby, and G. M. Hornberger. Ecological Modelling, Vol. 23, No. 2, p 1-24, May, 1984. 4 Fig, 4 Tab, 38 Ref.

Descriptors: *Photosynthesis, *Solar radiation, *Mathematical models, Simulation, Dissolved oxygen, Mass balance, Extended Kalman filter, Autotrophs, Streams.

The rate of photosynthesis (defined as the rate of The rate of photosynthesis (defined as the rate of oxygen release by photoautotrophs) determines the rate of energy input to an ecosystem. A general procedure is described which uses a noisy series of diel oxygen concentration measurements to test the adequacy of non-linear photosynthesis-light models containing uncertain parameters. The extended Kalman filter (EKF), used with an oxygen mass balance equation and observed stream oxygen concentrations, provides serial estimates of the state (oxygen concentration) and the model parameters. (oxygen concentration) and the model parameters

While the expected behavior of the innovations can be derived from theoretical considerations for linear systems, no such theory exists for non-linear systems. Simulated data were used to demonstrate that the theoretical criteria are applicable to non-linear photosynthesis-light models. Five mass balance equations containing photosynthesis-light relationships were each used with five different levels of system and parameter noise to produce 25 time series of oxygen concentration. The procedure was applied repetitively in attempts to identify adequate models for each of these data sets. In 1250 tests of model adequacy there were no Type I errors (failure to accept the correct model as a dequate) and the incidence of Type II errors (accepting as adequate an incorrect model) was less than 3%. The EKF estimation procedure is reliable and robust; it should be useful in examining the photosynthesis-light (P-I) relationship in streams. (Moore-IVI)

IDENTIFICATION OF PHOTOSYNTHESIS-LIGHT MODELS FOR AQUATIC SYSTEMS; II. APPLICATION TO A MACROPHYTE DOMI-NATED STREAM, Virginia Univ., Charlottesville. Dept. of Environ-mental Science.

tal Sciences

B. J. Cosby, G. M. Hornberger, and M. G. Kelly. Ecological Modelling, Vol. 23, No. 1/2, p 25-51, May, 1984. 5 Fig, 11 Tab, 18 Ref.

Descriptors: *Photosynthesis, *Solar radiation, *Macrophytes, *Aquatic plants, *Gryde River, *Denmark, Mathematical models, Extended Kalman filter, Dissolved oxygen, Autotrophs.

A recursive estimation technique, the extended Kalman filter (EKF), is used with stream oxygen data to identify photosynthesis-light (P-I) models Asiman litter (E.F.), is used with stream oxygen data to identify photosynthesis-light (P-I) models for the Gryde River. The Gryde river is a small second-order stream in the Jutland peninsula in Denmark. The autotrophic component of the stream is dominated by macrophytes. A detailed account is given of the procedures for establishing account is given of the procedures for establishing operating conditions for the EKF. The utility of the innovations based criteria for model discrimithe innovations ossed criteria for model discrimination using data from a natural system is demonstrated. Eight P-I models are examined using twelve sets of data. Application of the innovations-based criteria required athat all of the models be rejected as inadequate for all time periods examined. ined. A posteriori analysis of the models' failures indicated: linear models of the P-I relationship are inadequate for this river; photosaturation was a necessary characteristic of P-I models; static P-I models are inadequate for this river; all models were inadequate for this river; all models were improved by allowing temporal variation of the photosynthesis parameters. Unlike bulk data estimation techniques, recursive analysis techniques applied to a time series of environmental data provide objective a priori criteria of model adequacy and explicitly recognize uncertainty in the system and observations. (Moore-IVI) W85-00269

TEMPORAL SUCCESSION IN A DESERT STREAM ECOSYSTEM FOLLOWING FLASH FLOODING.

Arizona State Univ., Tempe. Dept. of Zoolog S. G. Fisher, L. J. Gray, N. B. Grimm, and D. E.

Ecological Monographs, Vol. 52, No. 1, p 93-110, March, 1982. 14 Fig, 8 Tab, 67 Ref. NSF grants DEB 77-24478 and DEB 80-04145.

Descriptors: *Succession, *Desert streams, *Flash floods, *Ecosystems, *Sycamore Creek, *Arizona, Algae, Invertebrates, Mayflies, Diptera, Diatoms, Primary productivity, Organic matter, Nitrogen,

Recovery of a desert stream after an intense flash flooding event is described as a model of temporal succession in lotic ecosystems. A late summer flood in Sycamore Creek, Arizona, virtually eliminated algae and reduced invertebrate standing crop 98%. Physical and morphometric conditions typical of the preflood period were restored in 2 d and the biota recovered in 2-3 wk. Algal communities responded rapidly and achieved a standing

crop of nearly 100 g/sq m in 2 wk. Community composition was dominated by diatoms early in succession and by filamentous greens and bluesuccession and by mamentous greens and blue-greens later. Macroinvertebrates also recolonized denuded substrates rapidly, largely by immigration of aerial adults and subsequent oviposition. Growth and development were rapid and several generations of the dominant mayfly and dipteran taxa were completed during the 1st mo of recov-ery. Invertebrate dry biomass reached 7.3 g/sq m in 1 mo. Gross primary production (Pe) measured taxa were completed during the 1st mo of recovery. Invertebrate dry biomass reached 7.3 g/sq m in 1 mo. Gross primary production (Pg) measured as O2 increased in a similar asymptotic fashion and reached 6.6 g/sq m/d in 30 d. Pg exceeded community respiration (R) after day 5 and Pg/R averaged 1.46 for the remainder of the 2-mo sequence. This ecosystem is thus autotrophic and exports organic matter downstream and by drying, laterally. Uptake of nitrate and phosphorus were proportional to net primary production and exhibited a marked downstream decline in concentration during both light and dark periods. Temporal trajectories of various community and ecosystem attributer. jectories of various community and ecosystem at-tributes are compared with those suggested by Odum (Science 164:262-270, 1969) to be diagnostic of successional status. Agreement was poor in at-tributes which are especially modified in open, frequently disturbed ecosystems such as streams. (Author's abstract) W85-00270

IMPORTANCE OF SEDIMENT IN THE GRAZ-ING ECOLOGY AND SIZE CLASS INTERACTIONS OF AN ARMORED CATFISH, ANCIS-

Washington Univ., Seattle. Dept. of Zoology. M. E. Power.

Environmental Biology of Fishes, Vol. 10, No. 3, p 173-181, April, 1984. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Catfish, *Ancistrus, *Stream sediments, *Rio Frijoles, *Panama, Sediments, Algae, Detritus, Fish behavior, Feeding, Seasonal varia-

In the Rio Frijoles of central Panama, many log and rock substrates are mantled with sediment, particularly during the dry season when water levels are low. Armored catfish, Ancistrus spinolevels are low. Armored cartish, Ancistrus spinosus, graze rock and wood substrates and ingest both attached algae and sediment that settles onto substrates. During the dry season, this sediment is organic-rich (18-24% ash-free dry weight), and is derived from decomposing periphyton and vegetation from the surrounding, largely deciduous forest. This sediment is not a food for Ancistrus, and imposes energetic costs. These costs were estimated to be 15-22% of the daily energy budgets of 10. g. individuals held under experimental condimated to be 13-22% of the daily energy oungers of 10 g individuals held under experimental conditions. In the stream, the presence of thick sediment on substrates increases the tendency for small Ancistrus to seek out larger individuals or areas cleared by them. Sedimentation is probably most stressful for Ancistrus in the Rio Frijoles during stressill for Ancistrus in the Rio Frijoles during the dry season. Sediment-free substrate is not in short supply during the rainy season, due to expan-sion of the habitat and the prevalence of deep, fast-flowing water. (Moore-IVI) W85-00279

DISTRIBUTIONAL PATTERNS OF SUN-FISHES ON THE NEW JERSEY COASTAL

Rutgers - The State Univ., Piscataway, NJ. Dept. of Biological Sciences.

J. H. Graham, and R. W. Hastings. Environmental Biology of Fishes, Vol. 10, No. 3, p 137-148, April, 1984. 4 Fig, 1 Tab, 53 Ref, 1

Descriptors: *Sunfish, *Ecological distribution, *New Jersey, *Pine barrens, Hydrogen ion concentration, Acidic waters, Aquatic habitats, Trophic level, Currents, Substrates, Fish food, Embryonic growth stages

Sunfishes of the genera Lepomis and Enneacanthus are characteristic inhabitants of quiet waters on the New Jersey coastal plain. In southern New Jersey, E. chaetodon and E. obesus are now almost totally restricted to the Pine Barrens region of the Outer

Coastal Plain. In contrast, E. gloriosus is widely distributed. Lepomis gibbosus and L. macrochirus are also widespread, but have established few populations in the more acidic waters of the Pine Barrens. Factor analysis was used to determine underlying patterns of distribution among these 5 species, using 6 habitat variables, measured over 54 collection sites in New Jersey. Two general factors account for 41% of the distributional variation. Habitat variables most strongly associated with factor 1 suggest an underlying trophic gradient (dystrophy to eutrophy) with its associated species. Factor 2 suggests an underlying current-bottom gradient. The basis for the scarcity of Lepomis spp. from acidic waters was explored by examining the tolerance of recently hatched embryos to reduced pH. No increase in mortality was observed at pH 4.25 for L. gibbosus eleutheroembryos and pH 4.5 for L. macrochirus eleutheroembryos and substrate of vystrophic habitats where most primary and secondary production is associated with aquatic macrophytes and substrate. (Author's abstract)

PRELIMINARY CLASSIFICATION OF RUN-NING-WATER SITES IN GREAT BRITAIN BASED ON MACRO-INVERTEBRATE SPE-CIES AND THE PREDICTION OF COMMUNI-TY TYPE USING ENVIRONMENTAL DATA, Oak Ridge National Lab., TN. Environmental Sciences Div

J. F. Wright, D. Moss, P. D. Armitage, and M. T.

Freshwater Biology, Vol. 14, No. 3, p 221-256, June, 1984. 4 Fig, 11 Tab, 47 Ref.

Descriptors: *Invertebrates, *Biological communi-ties, *England, *Scotland, *Wales, *Lotic environ-ment, Rivers, Aquatic environment, TWINSPAN, Detrended correspondence analysis, Multiple dis-

Macro-invertebrate species lists were obtained for 268 sites on forty-one river systems throughout Great Britain by qualitative sampling in spring, summer and autumn. Information on twenty-eight environmental variables was also collated for each site. The sites were ordinated on the basis of their species content using detrended correspondence analysis (DCA) and classified by two-way indicator species analysis (TWINSPAN). Correlation coefficients between ordination scores and single environmental variables indicated that Axis I distinvironmental variations micracie that Axis 2 reflect-guished between types of rivers and Axis 2 reflect-ed variation along the length of rivers. A prelimi-nary classification of sites into sixteen groups has been proposed, together with a key which allows new sites to be classified. Information on the spe-cies and environmental features which characterize new sites to be classified. Information on the species and environmental features which characterize each group is also presented. Multiple discriminant analysis (MDA) was employed to predict the group membership of the 268 sites using the twenty-eight environmental variables. 76.1% of other ways classified example. sites were classified correctly. An independent assessment of predictive ability using forty test sites yielded a 50% success rate. Predictive ability was higher for the classification presented in this paper than in fifteen additional classifications produced than in fifteen additional classifications produced using data from single seasons and/or different taxonomic treatments. TWINSPAN and MDA were found to be useful approaches to the classification of running-water sites by their macro-invertebrate fauna and the prediction of community type (as indicated by the occurrence of species in the sites comprising the group) using environmental variables. Extension of the scope of the classification, coupled with the use of additional environmental variables to increase predictive ability, is now in progress. (Author's abstract) W85-00293

MACROINVERTEBRATES AND FISH OF A COLORADO STREAM DURING A PERIOD OF FLUCTUATING DISCHARGE,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
S. P. Canton, L. D. Cline, R. A. Short, and J. V.

Freshwater Biology, Vol. 14, No. 3, p 311-316, June, 1984. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Stream biota, *Invertebrates, *Fish, *Low flow, *Trout Creek, *Colorado, Flow discharge, Drought, Trout, Sucker, Mayflies, Odonata, Ephemeroptera, Species composition.

Severe fluctuations in flow can have adverse effects on the biota of normally permanently flowing streams. During a 2-year study of the fish and macroinvertebrates of Trout Creek, a third-order montane stream, a severe drought in the first year resulted in a temporary cessation of surface flow. Flow was continuous during the second year. During the study, 72 invertebrate taxa were collected in the study area; only 20 were common. Some taxa (e.g. Ophiogomphus severus) exhibited higher density during the drought year, others declined in abundance during low flow (e.g. Baetis spp.) whereas a few (e.g. Tricorythodes minutus) appeared unaffected. Total macroinvertebrate density decreased by 50% during the low flow year spp.) whereas a tew to-appeared unaffected. Total macroinvertebrate den-sity decreased by 50% during the low flow year compared to the normal flow year. Mayflies were most severely affected, but also exhibited the most dramatic recovery. The collector-gatherer func-tional feeding group was abundant only during the normal flow year, whereas shredders and preda-tors exhibited increased relative abundance during low flow. Three fish species were collected during the study: brook trout, longnosed sucker and white sucker. Fish populations were severely reduced in the study: prook trout, longnosed sucker and white sucker. Fish populations were severely reduced in the low flow year. Fishes rapidly invaded the area following resumption of normal flow. Regenerated scales, which often indicate environmental stress, were found on many fish in 1979, after the drought year of 1978. (Moore-IVI) W85-00295

HYDROGEOCHEMISTRY OF BIG SODA LAKE, NEVADA: AN ALKALINE MEROMIC-TIC DESERT LAKE, Geological Survey, Menlo Park, CA. Y. K. Kharaka, S. W. Robinson, L. M. Law, and

W. W. Carothers. Geochimica et Cosmochimica Acta, Vol. 48, No. 4, p 823-835, April, 1984. 9 Fig, 5 Tab, 54 Ref.

Descriptors: *Big Soda Lake, *Nevada, *Chemical analysis, *Saline lakes, *Desert lakes, Alkaline water, Anaerobic conditions, Geochemistry, Mero-mictic lakes, Meteoric water, Minerals.

mictic lakes, Meteoric water, Minerals.

Big Soda Lake, located near Fallon, Nevada, occupies an explosion crater rimmed by basaltic debris; volcanic activity apparently ceased within the least 10,000 years. This 'ake has been selected for a detailed multidisciplinary study that will ultimately cover the organic and inorganic hydrogeochemistry of water and sediments because the time at which chemical stratification was initiated is known (about 1920) and chemical analyses are available for a period of more than 100 years. Detailed chemical analyses of the waters show that the lake is at present alkaline (pH = 9.7), chemically stratified (meromictic) and is extremely anoxic (total reduced sulfur - 410 mg/L as H2S) below a depth of about 35 m. The average concentrations (in mg/L) of Na, K, Mg, Ca, NH3, H2S, alkalinity (as HC03), Cl, S04, and dissolved organics (as C) in waters of the upper layer (depth 0 to 32 m) are 8,100, 320, 150, 5.0, < 0.1, < 0.5, 4,100, 7,100, 5,800, and 20 respectively; in the deeper layer (depth 37 to 64 m) they are 27,000, 1,200, 5.6, 0.8, 45, 410, 24,00, 27,300, 6,800, and 60 respectively. Chemical and stable isotope analyses of the waters, delta C-13 and Delta C-14 values of dissolved total carbonate from this lake and surface and ground waters in the area cogether with mineral-water equilibrium computations indicate that the waters in the lake are primarily meteoric in origin with the present chemical composition resulting from the following geochemical processes: (1) evaporation and exchange with atmosphere, the dominant processes, (2) mineral-water interactions, including dissolution, precipitation and ion exchange, (3) inflow and outflow of ground waters and (4) biological extension and exchange with atmosphere, the dominant processes, (2) mineral-water interactions, including dissolution, precipitation and ion exchange, (3) inflow and outflow of ground water and (4) biological extension and exchange with atmosphere, the dominant processes, (2) mineral-water interactions, including dissolution, precipitation and ion exchange, (3) inflow and outflow of ground water and (4) biological activity of macro- and microorganisms, in-

cluding sulfate reduction in the water column of the deeper layer at a very high rate of 6.6 micro mol/L/day. (Author's abstract) W85-00297

FACTORS CONTROLLING PRIMARY PRODUCTION IN A HYPERTROPHIC LAKE (HARTBEESPORT DAM, SOUTH AFRICA), National Inst. for Water Research, Pretoria (South

R. D. Robarts

Journal of Plankton Research, Vol. 6, No. 1, p 91-105, 1984. 9 Fig. 32 ref.

Descriptors: *Hartbeespoort Dam, *South Africa, *Primary productivity, Monomictic lakes, Reservoirs, Nitrogen, Phosphorus, Microcystis, Wind, Water temperature, Photosynthesis, Buoyancy, Solar radiation, Chlorophyll a.

water temperature, Photosynthesis, Buoyancy, Solar radiation, Chlorophyll a. Hartbeespoort Dam is a hypertrophic, warm, monomictic lake which lies near the cities of Pretoria and Johannesburg in South Africa. The very high nitrogen and phosphorus loads to the lake from the northern suburbs of Johannesburg ensure an overabundance of algal growth nutrients throughout the year. This study was done at a permanently buoyed station in the main basin. Weekly measurements were made at the surface, 0.5, 1, 2, 3, 4, 5, 6, 8, 10 and 15 m depths. The surface chlorophyll a concentration ranged from 2.7 mg/cu m (following overturn in April 1981) to 1180 mg/cu m (December 1981). The maximum rate of photosynthesis in the depth profile (Amax) ranged between 12.4 mg C/cu m/h in April 1981 and 5916 mg C/cu m/h in December 1981. Areal rates varied between 46.9 and 3381 mg c/sq m/h. The factors permitting and controlling production were subjectively separated into two categories. In category 1, nutrients (N + P), which were in overabundance, permitted large standing crops of Microcystis aeruinosa to develop (>1000 micro g chl a/l). Wind patterns determined the dramatic spatial and temporal changes in algal standing crop which could drop to 2.7 micro g chl a/l. In category 2 were the factors which affected the rate processes. The buoyancy mechanism of Microcystis usually kept the alga in the euphotic zone. The attenuation of light with increasing chlorophyll concentration was moderated in Hartbeespoort Dam because of the ability of microcystis to form large chlorophyll packages. Variations in solar radiation had a significant effect on the integrated daily production. The saturation parameter and photosynthetic capacity were temperature dependent. There is a significant correlation between water column stability and integral primary production in this hypertrophic lake. (Moore-IVI)

DISTRIBUTIONAL PATTERNS AND HABITAT CHARACTERISTICS OF AMPHIPODA (CRUSTACEA) IN THE INLAND WATERS OF ISRAEL AND SINAL,

Hebrew Univ., Herusalem (Israel). Dept. of Zoolo-

gy. G. N. Herbst, and C. Dimentman. Hydrobiologia, Vol. 98, No. 1, p 17-24, January, 1983. 4 Fig. 1 Tab, 29 Ref.

Descriptors: *Amphipods, *Crustaceans, *Distribution, *Aquatic habitats, *Israel, *Sinai, Biological oxygen demand, Chemical oxygen demand, Dissolved oxygen, Chlorides, Flow velocities, Sa

Nine amphipod species from six genera were collected from approximately 140 inland water sites in Israel and the Sinai. Included were museum specimens collected over 40 years ago from habitats now greatly modified. Water samples were taken for analysis during specimen collection. Nine species from six genera were identified: Gammarus syriacus, G. pseudosyriacus, Echinogammarus n. sp., E. foxi, E. veneris, Corophium orientalis, Orchestia cavimana, O. platensis, and Metacrangonyx n. sp. The nine species display two principal distribution patterns. A north-south pattern is typical of freshwater fauna in the Levant and is probably controlled by climatic factors; the distribution of

Field 2-WATER CYCLE

Group 2H-Lakes

the genus Gammarus is characteristic of this pattern. This pattern is distinguished from that dis-played by species of marine origin that penetrated into inland waters; the distribution of the genus Echinogammarus is similar to this pattern. Within Echinogammarus is similar to this pattern Echinogammarus is similar to this pattern. Within their ranges the common Gammarus and Echinogammarus species display differences in preference for current velocities, salinities and habitat types. Both Gammarus species collected require high disolved oxygen content (DO), low biological oxygen demand (BOD), and low chemical oxygen demand (GOD) these pages of good at objective of the content of demand (COD); they are never found at chlorini-ties greater than 170 ppm. The three Echinogam ues greater than 170 ppm. The three Echinogammarus taxa are all found under a wide range of environmental parameters, particularly chlorinity which varies from 21 ppm Cl(-) to more than 3500 ppm Cl(-). The relationships of chemical and physical parameters to amphipod distribution may have important management and conservation implications. (Collier-IVI)

TRANSPORT OF ORGANIC CARBON IN THE ATCHAFALAYA BASIN, LOUISIANA, Office of Radiation Programs-Las Vegas Facility,

NV.
V. W. Lambou, and S. C. Hern.
Hydrobiologia, Vol. 98, No. 1, p 25-34, January,
1983. 2 Fig. 5 Tab, 30 Ref.

Descriptors: *Atchafalaya River Basin, *Lousiana, *Organic carbon, *Solute transport, Dissolved solids, Particulate matter, Cycling nutrients, Nutri-ent removal, Sedimentation, Flooding.

The Atchafalaya Basin comprises an 8345 sq km lowland area within Louisiana. Annual organic carbon fluxes were determined for the 2129 sq km Atchafalaya Basin Floodway, which is subject to frequent and prolonged natural flooding, and for subunits within the Floodway. During the period of July 1976 to June 1977, 36 pairs of samples were collected at approximately monthly intervals from an inlet and from outlets of the Atchafalaya Basin. s were also collected from 11 stations located at all inlets and outlets to three hydrologic subunits. Samples were analyzed for dissolved or-ganic carbon (DOC), total organic carbon (TOC), and particulate organic carbon (POC). Net change in water volume representing storage changes as a result of inflow, outflow, or a combination of the result of inflow, outflow, or a combination of the two was calculated. Carbon fluxes were deter-mined by multiplying carbon concentrations times flow volumes at each major opening of the various hydrological subunits. Comparisons are made with an area not subject to extensive overflow due to its isolation from the Atchafalaya River by manmade solution from the Alcharanya River by manmade levees. The three overflow subunits were found to have a large areal net export of DOC; values were 10,000, and 10,600, and 11,600 kg/sq km. The non-overflow subunit had a low net DOC export of 1100 kg/sq km. Areal export of POC was high in the reconception where 16 kg/sq km. Areal export of POC was high in the non-overflow subunit (8400 kg/sq km) while the overflow subunits acted as sinks for particulate organic carbon. The Atchafalaya Basin Floodway, as a whole, acted as a major sink for TOC through the sedimentation of POC. Prolonged overbank flooding, with the annual inundation of additional land areas and the decomposition of herbaceous materials and forest litter, renews the supply of organic carbon. (Collier-IVI) Wis-00396

SUCCESSION OF PLANKTONIC ROTIFER POPULATIONS IN SOME LAKES OF THE EASTERN RIFT VALLEY, KENYA, Concordia Univ., Loyola Campus, Montreal

(Quebec). T. Nogrady.

Hydrobiologia, Vol. 98, No. 1, p 45-54, January, 1983. 7 Fig. 5 Tab, 21 Ref.

Descriptors: *Rotifers, *Succession, *Plankton, *Eastern Rift Valley, *Kenya, Lake Naivasha, Lake Oloidien, Lake Victoria, Lake Nakuru, Lake Elmenteita, Lake Bogoria, Conductivity, Alkalinity, Saline lakes, Alkaline lakes, Biomass.

The quantitative succession of the spring and summer rotifer plankton and its biomass in six lakes of the Eastern Rift Valley of Kenya is discussed.

The lakes can be divided into two groups: the low conductivity slightly alkaline lakes Naivasha, Oloi-dien and the Winam Gulf of Lake Victoria; and the dien and the Winam Gulf of Lake Victoria; and the high conductivity, highly alkaline-saline lakes Nakuru, Elmenteita and Bogoria. The former three show a qualitatively rich, typical warmwater rottfer association dominated by Brachionids and Filinia. The saline soda lakes are dominated by several populations of Brachionus dimidiatus, which can reach enormous numbers. The taxonomy and bireach enormous numbers. The taxonomy and biometry of this species was subjected to statistical
analysis. Some interesting and rare species are described: Anuraeopsis coelata, Lepadella triptera f.
deconincki, Trichocerca gracilis and T. mus. The
chemical limnology of the lakes is discussed and
compared with other soda lakes in Central Africa,
Europe and North America. (Author's abstract)
W85-00398

INVERTEBRATE DRIFT, DISCHARGE, AND SEDIMENT RELATIONS IN A SOUTHERN APPALACHIAN HEADWATER STREAM,

Georgia Univ., Athens. Dept. of Entomology. J. O'Hop, and J. B. Wallace. Hydrobiologia, Vol. 98 No. 1, p 71-84, January, 1983. 8 Fig. 8 Tab, 40 Ref. NSF grant 77-05234

Descriptors: *Aquatic drift, *Suspended sediments, *Invertebrates, *North Carolina, *Hugh White Creek, Stream discharge, Seston, Detritus, Aquatic insects, Caddisflies, Plecoptera.

Drift, the downstream transport of invertebrates in the water column, is an integral part of the food web of running waters since drifting organisms are utilized by some stream fish and by filter-feeding insect larvae. Drifting invertebrates and suspended sediments were collected at monthly intervals, from June 1977 to May 1978, from Hugh White Creek a small second order mountain beadwater. Creek, a small second order mountain headwater stream in Macon County, North Carolina. Non-storm export and concentrations of detritus and inorganic sediments were lowest in early summer after several weeks of calm weather and a slowly descending hydrograph. Coarse detritus concentra-tion also decreased in December. The numbers and biomass of drifting organisms reflected the seasonal cycles of aquatic insects. Some aquatic organisms showed behavioral drift either during a sample day cycles of aquatic insects. Some aquatic organisms showed behavioral drift either during a sample day or during some portion of their life cycle. Parapsyche cardis and Diplectrona modesta dispersed as first instar larvae; few later instars of these two net-spinning caddisflies drifted. The drift of nymphal Peltoperla maria was apparently related more to detritus transport than to benthic densities or discharge alone. The general level of stream invertebrate drift appears to be related to detritus transport; drift during storms is also related to detritus transport. During storms, terrestrial invertebrate drift was related to rainfall intensity, canopy washing, and channel expansion. Drift density of aquatic invertebrates in Hugh White Creek was within the raage of previously reported values for other streams, but the estimate of yearly export (aquatic invertebrates = 134 g/y; terrestrial invertebrates = 23 g/y) is lower reflecting the smaller size of Hugh White Creek in comparison with those other streams. (Collier-IVI)

AQUATIC CRYPTOGRAMS OF NATURAL ACID SPRINGS ENRICHED WITH HEAVY METALS: THE KOOTENAY PAINT POTS, BRITTISH COLUMBIA, Durham Univ. (England), Dept. of Botany.

J. D. Wehr, and B. A. Whitton.
Hydrobiologia, Vol. 98 No. 2, p 97-105, January, 1983. 3 Fig. 7 Tab, 28 Ref. Department of Environment grant DGR/480/571.

ronment grant DGR/480/571.

Descriptors: *British Columbia, *Kootenay Paint Pots, *Acid springs, *Heavy metals, Paint pots, Algae, Mosses, Liverworts, Anaerobic conditions, Chlamydomonas, Acid mine drainage.

An account is given of the chemistry and aquatic cryptograms of the Kootenay Paint Pots, British Columbia. The waters fell in the pH range 3.2 to 4.0, were mostly anaerobic, and had high levels of Fe and Zn. Fourteen species of algae, one liver-

wort (Cephalozia bicuspidata) and one moss (Di-cranella heteromalla) were found in the various springs and pools. The two dominant Chlamydo-monas species existed as palmelloid growths where they occurred among sediments, while Dicranella heteromalla occurred everywhere only as protonheteromalla occurred everywhere only as proton-ema. The flora is different in many respecis from that of typical acid mine drainages, the Dicranella being the only one of eight common species in such drainages represented. Most of the photosyn-thetic organisms in the Paint Pots must tolerate anaerobic conditions for long periods and it is suggested that this may be a key factor explaining the floristic difference. (Author's abstract)

MICROBIOLOGICAL EXAMINATION OF LAKE ERIE AND LAKE ONTARIO SEDI-

National Water Research Inst., Burlington (Ontar-io). Analytical Methods Div. B. J. Dutka, and K. K. Kwan. Hydrobiologia, Vol. 98, No. 2, p 135-145, January, 1983. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Lake Erie, *Lake Ontario, *Lake sediments, *Bacterial analysis, Sediments, Oxida-tion-reduction potential, Bacteria, Hydrogen ion concentrations, Organic carbon, Heterotrophic

Diver collected cores of similar type sediments Diver collected cores of similar type sediments from within the Lower Great Lakes were found to have numerically similar microbial flora regardless of the site of collection; overlying water samples were also collected. Cores from three sites in Lake Erie (west of Cleveland, Eastern basin and near Buffalo) and one from Lake Ontario near the mouth of the Niagara River, were sectioned to 20 cm and examined for sulfur cycle and nitrogen cycle bacteria, heterotrophic bacteria, insoluble orcycle bacteria, heterotrophic bacteria, insoluble or-ganic and inorganic phosphate solubilizing bacteria and manganese oxidizing bacteria. Eh, pH, nitro-gen, organic carbon and percentage moisture de-terminations were also made. There was a lack of correlation between microbial populations, organic content, Eh, and oxygen consumption rates. Heter-otrophic bacterial populations recorded in this study confirm the typical heterotrophic distribu-tion patterns encountered in Lake Erie and Lake Ontario sediments. The heterotrophic bacterial populations are a reflection of the number of heterotrophics capable of surviving by facultative and obligate mechanisms in an anaerobic environment. (Collier-IVI) W85-00403

STRATIFICATION OF MICROORGANISMS AND NUTRIENTS IN THE SURFACE MICRO-LAYER OF SMALL FRESHWATER PONDS, Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.

S. C. Danos, J. S. Maki, and C. C. Remsen Hydrobiologia, Vol. 98, No. 3, p 193-202, February, 1983. 2 Fig, 6 Tab, 37 Ref.

Descriptors: *Microorganisms, *Nutrients, *Stratification, *Surface water, Ponds, Microlayers, Pigments, Bacteria, Phototrophs, Epilimnetic waters.

The location of the surface microlayer guarantees that both its physical and chemical composition will be significantly different from the subsurface waters. Stratification within the surface micro-layers of two small experimental ponds was examined and the distribution of nutrients, pigments and bacteria within upper epilimnetic waters was invesoacteria within upper epinimetic waters was inves-tigated. The two ponds (at the University of Wis-consin-Milwaukee field station) were sampled 20 times from June, 1978 through August, 1979. Using two different surface microlayer sampling devices (the Harvey and Burzell glass plate and the Garrett screen), two microlayer fractions could be distinguished. The first was from 0 to 50 micro m and the second was from 51 to 320 micro m. Significantly different (p < 0.05) concentrations of dis-solved nutrients between the two microlaver fractions strongly suggests stratification within the sur-face microlayer. This apparent stratification is also examined for phototrophs, bacteria and other material found within the surface microlayer. (Moore-IVI) W85-00407

RELATIONSHIP BETWEEN FOSSIL DIATOM ASSEMBLAGES AND LIMNOLOGICAL CON-

Southern Illinois Univ. at Edwardsville. Dept. of

Southern Hindos Univ. at Edwardsvine. Dept. of Biological Sciences. R. B. Brugam. Hydrobiologia, Vol. 98, No. 3, p 223-235, Febru-ary, 1983. 4 Fig. 3 Tab, 27 Ref. NSF grants EAR76-01412 and DEB 8004286, OWRT grant B-

Descriptors: *Minnesota, *Diatoms, *Fossils, *Limnology, Alkalinity, Sulfates, Phosphorus, Transparency, Water depth, Cluster analysis, Eutrophic lakes, Oligotrophic lakes, Acid lakes, Meromictic lakes.

Fossil diatom assemblages from the sediment/water interface in 105 Minnesota lakes were compared with measurements of alkalinity, sulfate, total phosphorus, transparency, and water depth at the sample site. Similar assemblages were placed together using cluster analysis and comparisons of environmental variables between diatom clusters were made using an analysis of variance. Total alkalinity and transparency showed the greatest difference among clusters. Samples from shallow eutrophic prairie lakes were dominated by Melosira granulata, Stephanodiscus niagarae and, occasionally, by Stephanodiscus niagarae and, occasionally, by Stephanodiscus hantzachii. Deep oligotrophic lakes had modest percentages of Cyclotella comta. Dilute acid lakes were dominated either by Melosira distans and M. italica or by Tabellaria fenestrata, Cyclotella stelligera, and in some cases C. glomerata. Assemblages with Cyclotella glomerata and Synedra nava were found in naturally meromictic lakes. Stephanodiscus hantzschii showed a preference for extremely eutrophic lakes. The relationships between recently deposited diatom assemblages and the lake supriormental The relationships between recently deposited diatom assemblages and the lake environmental conditions studied here can be used to evaluate the extent of past environmental change in lakes. (Author's abstract)

ANNUAL CYCLE OF GROSS PRIMARY PRO-DUCTION AND RESPIRATION IN THE VIROIN RIVER (BELGIUM), Brussels Univ. (Belgium). Lab. de Traitement des

Eaux et Pollution.
P. Servais, E. Debecker, and G. Billen.
Hydrobiologia, Vol. 111, No. 1, p 57-63, 1984. 7
Fig. 2 Tab, 13 Ref.

Descriptors: *Primary productivity, *Viroin River, *Belgium, *Respiration, Dissolved oxygen, Aeration, Ranunculus, Macrophytes, Solar radiation, Decomposition, Seasonal variation.

The quality of river water depends to a great extent upon the dissolved oxygen content. This is regulated by the equilibrium among three processes: exchange of oxygen with the atmosphere, production of oxygen by photosynthesis and consumption of oxygen by respirators. Green primary and processing of the programment tion of oxygen by respiration. Gross primary production, community respiration and reaeration coefficient were determined during an annual cycle on the Viroin River (South Belgium), based on the on the Viroin River (South Belgium), based on the daily variations of dissolved oxygen concentration. The Viroin is a shallow tributary of the Meuse River, in which the primary producers are dominated by the macrophyte Ranunculus fluitans. Reacration coefficient remains remarkably constant (0.26/h) during the year in spite of discharge variations. Primary production parallels the variations of total solar radiation, and ranges from 0 in winter to 8 g O2/sq m/d in summer. In spring and summer, respiration variations parallel those of primary production (average value: 10 g O2/sq m/d); in the dry autumn, decomposition of dying macrophytes considerably enhances the community respiration (15 g O2/sq m/d). No oxygen problems occur during the winter. In late spring and summer the river exhibits a moderate eutrophication with important daily fluctuations of dissolved oxygen. The most critical situation, in terms of deficit in the oxygen status, is encountered during the dry

autumn where high respiration occurs due to the decomposition of dying macrophytes. (Moore-IVI) W85-00413

EFFECTS OF A MASSIVE SWARM OF ANTS ON AMMONIUM CONCENTRATIONS IN A SUBALPINE LAKE, Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station. R. G. Carlton, and C. R. Goldman. Hydrobiologia, Vol. 111, p 113-117, 1984. 2 Fig. 19 Ref.

Descriptors: *Castle Lake, *California, *Ants, *Swarming, *Ammonium, *Subalpine lakes, Nutrients, Primary productivity, Fish, Phytoplankton.

ents, Primary productivity, Fish, Phytoplankton.

Castle Lake is a small, dimictic, subalpine lake lying in a granitic cirque basin at an elevation of 1706 m in the Klamath Mountains of northwestern California. On August 9 and 26, 1979, massive lights of alates of the ground dwelling ant Lasius alienus descended upon the surface of Castle Lake. Each event resulted in the delivery of millions of ants to the lake surface. Consumption and subsequent excretion by fish, in addition to direct release from ants, produced a brief, but marked increase in water column ammonium levels. Castle Lake phytoplankton are often nitrogen limited and possess a high affinity for ammonium. Cloudy weather which followed the ant swarming events may have masked any effect on productivity. Implications for nutrient limited systems include the role of spatial and temporal heterogeneity of nutrients in algal community dynamics, with respect to shifts in nutrient ratios and concentrations, as well as enhancement of overall primary production. (Moore-IVI)

VERTICAL DISTRIBUTION OF ORGANIC CONSTITUENTS IN AN ANTARCTIC LAKE: LAKE VANDA,
Tokyo Metropolitan Univ. (Japan). Dept. of

Chemistry.
G. Matsumoto, T. Torii, and T. Hanya.
Hydrobiologia, Vol. 111, No. 2, p 119-126, April 1984. 6 Fig, 35 Ref.

Descriptors: *Organic carbon, *Antarctic, *Lake Vanda, *Vertical distribution, Stratification, Hy-drocarbons, Lake sediments, Sterols, Fatty acids, Phenolic acids, Decomposition, Anaerobic condi-

Vertical distribution of organic constituents, i.e. total organic carbon (TOC), extractable organic carbon with ethyl acetate (EOC), hydrocarbons, phytol, sterols, fatty acids and phenolic acids in Lake Vanda was studied to elucidate their features to the stratification of lake water and the distribution of lake organisms. The concentrations of TOC, EOC and sterols increased with depth and attained the maximum values of 25 and 1.5 mg C/l and 1.4 micro. g/l in the bottom researchice. and 1.4 micro g/l in the bottom, respectively, while those of fatty acids showed the maximum value of 61 micro g/l at a depth of 55.4 m, along with the highest value of the ratio of unsaturated with the highest value of the ratio of unsaturated (uC16, uC18) to saturated (C16, C18) acids (8.5) and with the highest carbon preference index (35). Hydrocarbons were only found in the bottom layers (60.4 and 65.9 m) and bottom sediment. These results suggest strongly that the westless nayers (60.4 and 65.9 m) and bottom sediment. These results suggest strongly that the vertical distribution of lake organisms and their activity are quite different due to depth. In the bottom warm anoxic layers the degradation of organic materials must have occurred significantly and thus refractory organic materials should be concentrated. (Author's abstract) W85-00418

COST AND PRECISION IN A STREAM SAM-PLING PROGRAM, Montana Univ., Missoula. Dept. of Zoology. For primary bibliographic entry see Field 6A. W85-00420

EXCHANGE BETWEEN INTERSTITIAL AND SURFACE WATER: IMPLICATIONS FOR

STREAM METABOLISM AND NUTRIENT CY-

CLING,
Arizona State Univ., Tempe. Dept. of Zoology.
N. B. Grimm, and S. G. Fisher.
Hydrobiologia, Vol. 111, No. 219-228, 1984. 1 Fig.
6 Tab, 45 Ref. NSF grant DEB 80-04145.

Descriptors: *Streams, *Metabolism, *Surface water, *Interstitial water, *Cycling nutrients, *Sycamore Creek, *Arizona, Ecosystems, Respiration, Oxygen, Nitrates, Primary productivity, Hy-

Summertime stream metabolism was studied in a 30-m reach of Sycamore Creek, Arizona by both enclosure and whole system oxygen techniques. Recirculating chambers were used to estimate surface sediment metabolism and measured deep sediment respiration in isolated sediment cores. The study was done on 6 and 17 August 1982, 14 and 25 days after a resetting flash flood of 2 cu m/s occurred at the site. Metabolism of the stream ecosystem was determined for the reach as dark and light oxygen change with and without black ecosystem was determined for the reach as dark and light oxygen change with and without black plastic sheeting that darkened the stream and prevented diffusion. Average ecosystem respiration for two dates in August (440 mg O2/sq m/h) exceeded respiration of either that surface sediment community (155 mg O2/sq m/h) or the hyporheic community (170 mg O2/sq m/h) alone. Deep sediments show substantial oxygen and niterate producents show substantial oxygen and niterate producents. community (10 mg 02/14q m/n) atome. Deep semi-ments show substantial oxygen and nitrate uptake when isolated. In the stream, this low nitrate inter-stitial water is exchanged with surface water. Me-tabolism of the isolated surface community sug-gests a highly productive and autotrophic system, yet gross production is balanced or exceeded by yet gross production is balanced or exceeded by community respiration when ecosystem boundaries include the hyporheic zone. Despite high rates of gross primary production (600-1200 mg O2/sq m/h), desert streams may be heterotrophic (Pg < R) during summer. The substantial contribution of the hyporheic community to whole security metable. hyporheic community to whole ecosystem metabolism argues strongly for inclusion of deep sediments in conceptualizations of stream ecosystems. W85-00422

COLONIZATION AND SUCCESSION OF BENTHIC MACROINVERTEBRATES IN A NEW RESERVOIR,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
For primary bibliographic entry see Field 6G.
W85-00425

ANIMAL COMMUNITY STRUCTURE AS A FUNCTION OF STREAM SIZE,

Lund Univ. (Sweden). Dept. of Animal Ecology. C. Bronmark, J. Herrmann, B. Malmqvist, C. Otto, and P. Sjostrom.

Hydrobiologia, Vol. 112, No. 73-79, 1984. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Stream size, *Invertebrates, *Distribution, *Bornholm, *Denmark, Water quality, Nutrients, Insects, Aquatic animals, Habitats.

variety of abiotic factors affect the occurrence of stream-living invertebrates, but these factors alone seldom explain the occurrence of certain species in closely situated streams of similar size. Differences in faunal composition were analyzed for small, closely situated coastal streams exposed to similar abiotic conditions, and between which dispersal should be high since most of the inverte-bester base uniqued. dispersal should be high since most of the inverte-brates have winged stages. The investigation was carried out in 22 Bornholm (Denmark) streams. The species-area relationship of the island biogeo-graphy theory was calculated for macroinverte-brates in the 22 streams. A z-value of 0.19 was obtained. The low a value was probably a company. braies in the 22 streams. A z-value of 0.19 was obtained. The low z-value was probably a consequence of the short distances between streams as well as high dispersal rates. A cluster analysis based on the dissimilarity of species assemblages showed that stream size was of prime importance in categorizing the streams. Although stream size seemed to be the main factor governing the number of species present, nutrient load also affected the species distribution. The increase number of species with area is probably associated with the

Group 2H-Lakes

crease in the number of microhabitats. (Moore-IVI) W85-00426

2L Water In Plants

WATER TRANSFER IN PLANTS; III. - SIMULATION OF THE INFLUENCE OF CANOPY PARAMETERS FOR DIURNAL DEVELOPMENT OF LEAF WATER POTENTIAL (TRANSFERT HYDRIQUE DANS LE VEGETAL; III. - SIMULATION DE L'INFLUENCE DES PARAMETRES DU COUVERT SUR L'EVOLUTION DIURNE DU POTENTIEL HYDRICHE FOLIABLE). QUE FOLIARIE), Institut National de la Recherche Agronor

Institut Nanonal de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie. N. Katerji, M. Hallaire, and R. Durand. Acta Oecologica: Series Oecologica Plantarum, Vol. 5, No. 2, p 107-117, 1984. 2 Fig. 2 Tab, 13 Ref.

Descriptors: *Leaves, *Water potential, *Transpiration, *Stomatal transpiration, Plant water reserves, Canopy, Plant tissue.

A model for water transfer in plants permits calculation of the evolution of leaf potential psi-F during the course of the day. The calculations undertaken successively varied the parameters in 1 to 2 and 1 to 4 proportions and allowed for a complete control of the course th to 2 and 1 to 4 proportions and allowed for a regular variation in transpiration during the course of the day, excluding consequently the case of variable weather days as well as the phenomenon of stomatal regulation. In the graphs of psi sub F as a function of time and in the times at which psi sub F reaches a given value, one can appreciate the respective influences of the four parameters (R, V/rho, r, psi sub pc) characteristic of a plant canopy. One finds, of course, the previously underlined preponderant influence of resistance R. But the novelty is the almost equivalent influence (under certain conditions) of the V/rho and psi-pc parameters which determine the mobilization of plant water reserves. (Author's abstract) WAS DOORS

MOISTURE STRESS EFFECTS ON BIOMASS PARTITIONING IN TWO SONORAN DESERT ANNUALS.

ANNUALS, Arizona State Univ., Tempe. Dept. of Botany and Microbiology. S. R. Szarek, S. D. Smith, and R. D. Ryan. American Midland Naturalist, Vol. 108, No. 2, p 338-345, October, 1982. 1 Fig. 5 Tab, 11 Ref.

ors: *Soil water, *Waster stress, growth, *Deserts, Moisture deficiency, Drought, Plant reproduction, Biomass partitioning, Arid lands, Plantago, Schismus.

The relative biomass accumulation rate and alloca-tion to reproduction were quantified for Plantago insularis and Schismus barbatus, growing under four different levels of moisture stress. As the growing season progressed and ambient tempera-tures rose, the incremental irrigations increased the growing season progressed and amtonient temperatures rose, the incremental irrigations increased the
whole plant growth rates progressively for both
species. Plants of Plantago from control, low, and
medium irrigation treatments reached their peak
seasonal biomass on the 7 April sampling date,
whereas plants of the high irrigation treatment did
not reach their peak seasonal biomass until 21
April. Peak seasonal biomass values were 23.3
(control), 28.4 (low irrigation), 38.2 (medium irrigation) and 40.9 (high irrigation) mg dry weight/
plant. All plants of Schismus reached their peak
seasonal biomass at the last sampling time. These
values were 14.4 (control), 18.0 (low irrigation),
24.5 (medium irrigation), and 49.5 (high irrigation)
mg dry weight/plant. Irrigation also affected the
survival of plants following imitial germination and
the occurrence of subsequent germination events,
both of which influenced the density of plants in
the experimental plots. None of the water treatments markedly altered the relative foliar growth
rate of either species. Schismus responded to water ments maintening altered the relative from growth mate of either species. Schismus responded to water input by significantly increasing the biomass allocated to reproduction, which increased relative reproductive allocation. The computed reproduc-

tive allocation of Plantago was not correlated with water input, although the ultimate reproductive biomasses were correlated with the summation of plant moisture stress during reproduction. Thus, the bar-day formulation is useful in estimating the relative sensitivity of reproduction to drought for native annual species growing in similar habitats with varying levels of moisture stress. (Baker-IVI)

PLANT RESPONSES TO FLOODING OF SOIL, Wisconsin Univ.-Madison. Coll. of Agricultural

T. T. Kozlowski. BioScience, Vol. 34, No. 3, p 162-167, March, 1984. 5 Fig, 54 Ref.

Descriptors: *Plant growth, *Flooding, Photosynthesis, Minerals, Absorption, Hormones, Plant pathology, Oxygen, Flood tolerance.

Flooding of soil rapidly depletes soil oxygen and alters plant metabolism, thereby inhibiting growth. Reduced growth is preceded by stomatal closure, reduced photosynthesis, carbohydrate translocation, and mineral absorption; as well as altered hormone balance. Flood tolerance varies widely hormone balance. Flood tolerance varies widely among plant species, cultivars, and ecotypes and is associated with both morphological and physiological adaptations. Mineral uptake of flooded plants is complicated and variously influenced by soil type, specific mineral ions absorbed, effects of anaerobiosis on mechanisms of ion absorption, and flood tolerance of different species of plants. Flooding of soil for more than a brief period adversely affects growth of most plants by inhibiting seed germination, leaf initiation and expansion, internode elongation, cambial growth, and root growth. Prolonged flooding is often fatal to higher plants. Flood-tolerant plants adapt to anaerobic environments by various mechanisms, depending on the species and environmental conditions. Important morphological adaptations include formation of aerenchyms, hypertrophy of lenticels, and tion of aerenchyma, hypertrophy of lenticels, and regeneration of new roots. Others depend on their ability to transport air from leaves to roots. (Baker-IVI) W85-00126

RIPARIAN FORESTS AS NUTRIENT FILTERS

RIVARIAN FUNCESIS AS NOTHERS FILLERS IN AGRICULTURAL WATERSHEDS, Georgia Coastal Plain Experiment Station, Tifton. R. Lowrance, R. Todd, J. Fail, Jr., O. Hendrickson, Jr., and R. Leonard. BioScience, Vol. 34, No. 6, p 374-377, June, 1984. 2 Fig. 1 Tab, 18 Ref. NSF grants DEB 78-10841 and DEB 32-07210.

Descriptors: *Riparian vegetation, *Agricultural watersheds, *Nutrient removal, Sediment transwatersneds, "Nutrient removal, Sediment transport, Path of pollutants, Forests, Sodium, Phosphorus, Potassium, Magnesium, Chloride, Water rollution control

Riparian vegetation (streamside) may help control transport of sediments and chemicals to stream channels. Studies of a coastal plain agricultural watershed showed that riparian forest ecosystems are excellent nutrient sinks and buffer the nutrient discharge from surrounding agroecosystems. Nutrient uptake and removal by soil and vegetation in them uptake and remova is 90n and orgetation in the riparian forest ecosystem prevented outputs from agricultural uplands from reaching the stream channel. The watershed studied is 1568 ha with 30% riparian forest, 44% row crops, 13% pasture, and 16% roads, residences, fallow land, and other uses. Annual inputs of nutrients in fertilizer and uses. Annual inputs of nutrients in fertilizer and lime to row crops and pastures in the uplands are high. Inputs, outputs, and vegetation storages of N, P, K, Ca, Mg, and Cl in the riparian ecosystem were measured from 1979 to 1981. Waterborne inputs exceeded streamflow outputs for all elements. The riparian ecosystem can apparently serve as both a short- and long-term nutrient filter and sink if trees are harvested periodically to ensure a net uptake of nutrients. Based on this study, sood water quality for agricultural waterstudy, good water quality for agricultural water-sheds depends largely on nutrient uptake and removal in the riparian ecosystem. Removal of the riparian forest, accompanied by tile drainage, would tend to contribute to higher nutrient loads

in streams and lower water quality through loss of nutrient uptake and storage by woody vegetation. (Baker-IVI)

WATER BALANCE AND PATTERN OF ROOT WATER UPTAKE BY A QUERCUS COCCI-FERA L. EVERGREEN SCRUB,

Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosocio-logiques et Ecologiques Louis-Emberger. S. Rambal.

Oecologia, Vol. 62, No. 1, p 18-25, 1984. 6 Fig, 2 Tab. 41 Ref.

Descriptors: *Plant water balance, *Root water uptake, *Oak, *Scrub, *France, Evapotranspiration, Soil water, Drainage, Seasonal variation,

The Querous coccifera evergreen scrub (garrigue) covers more than 100,000 ha in the south of France. The water balance of a Q. coccifera evergreen scrub was studied over 7 consecutive years. The study site is located 10 km north of Montpelier, at the top of a west-facing 15% slope. The karst formation is heterogenous and composed of soft to hard limestone covered with a very shallow soil mantle. Soil water content was measured with a neutron meter; calibration curves were calculated from the thermal neutron macroscopic cross-sections of soil (< 2-mm fraction) and rock samples, and the profile of wet bulk density measured sections of soil (< 2-mm fraction) and rock sam-ples, and the profile of wet bulk density measured with a subsurface gamma-ray gauge. The annual and seasonal patterns of actual evapotranspiration and of deep drainage were calculated using field-measured drainage characteristics. The soil water content data were used to compute water uptake rates and pattern for the root zone over a 4-month drying period. The 906 mm of mean annual pre-cipitation yielded 603 mm of actual evapotranspiradrying period. The 906 mm of mean annual pre-cipitation yielded 603 mm of actual evapotranspira-tion (AET) and 296 mm of drainage. No drainage occurred with precipitation less than 578 mm. The average AET values for the months from April to September were 57, 74, 89, 96, 70, and 42 mm respectively. Q. coccifera consumed considerable quantities of water from the soil-rock complex. Poots could extract 270 mm of surker in the first quantities of water from the soil-rock complex. Roots could extract 270 mm of water in the first 470 cm of soil. There was a gradual downward shift of the zone of maximum root water uptake as the soil dried. (Moore-IVI)

EFFECT OF DIFFERENT GROWING CONDI-TIONS ON WATER RELATIONS PARAMETERS OF LEAF EPIDERMAL CELLS OF TRADESCANTIA VIRGINIANA L,

Bayreuth Univ. (Germany, F.R.). E. Brinckmann, S. D. Tyerman, E. Steudle, and E. Oecologia, Vol. 62, No. 1, p 110-117, 1984. 7 Fig, 1 Tab, 32 Ref. D. Schulze.

Descriptors: *Tradescantia, *Plant water relations, *Solar radiation, *Air temperature, *Humidity, *Nutrients, Turgor, Volumetric elastic modulus, Plant water potential, Permeability coefficient,

Tradescantia virginiana L. plants were cultivated radicscantia viginata L. plants were cuntivated under contrasting conditions of temperature, humidity, light quality and intensity, and nutrient status in order to investigate the effect of growth conditions on the water relations parameters of the leaf epidermal cells. Turgor pressure (P), volumetric elastic modulus (epsilon), half-time of water potential equilibration (T 1/2), hydraulic conductivity (Lp) were measured with the miniaturized pressure probe in single cells of the upper and lower epidermis of leaves. Turgor differed (range: 0.1 bar to 7.2 bar) between treatments with lowest values under warm and humid conditions and addivalues under warm and numic conditions and addi-tional supply of fertilizer, and highest values under conditions of low air humidity and low nutrient supply. The volumetric elastic modulus changed by 2 orders of magnitude (range: 3.0 bar to 350 bar, 158 cells), but epsilon was only affected by the treatments, in as much as it was dependent on turgor. The turgor dependence of epsilon, meas-ured on intact leaves of T. virginiana, was similar

Erosion and Sedimentation—Group 2J

to that for cells of the isolated (peeled) lower epidermis, where epsilon as a function of turgor was linear over the whole range of turgors. This result has implications for the discussion of pressure/volume curves as measured by the pressure bomb where changes in 'bulk leaf epsilon' are frequently discussed as 'adaptations' to certain treatments. The measurements of the hydraulic conductivity indicate that this parameter varies between treatments (range of means: 0.0000124 cm/s/bar.) There was a negative correlation for Lp in cells of intact leaves as a function of turgor which was altered by the growing conditions. However, a correlation with turgor could not be found for cells from isolated epidermis or cells from a uniform population of epidermis or cells from a uniform population of plants. The large variation in Lp from cell to cell plants. The large variation in Lp from cell to cell observed in the present and in previous studies was accounted for in a study of 100 cells from a uniform population of plants by the propagation of measurement errors in calculating Lp. The results suggest that in T. virginiana cellular water relations are changed mainly by the turgor dependence of epsilon. (Author's abstract) W85-00208

DROUGHT STRESS AND THE DEMISE OF ACACIA ALBIDA ALONG THE LOWER KUISEB RIVER, CENTRAL NAMIB DESERT: PRELIMINARY FINDINGS, Natal Univ., Durban (South Africa). Dept. of

Botany. For primary bibliographic entry see Field 2B. W85-00215

RESISTANCES TO WATER FLOW THROUGH THE SOIL-PLANT SYSTEM, Soil and Irrigation Research Inst., Pretoria (South

Africa). D. M. Oosterhuis.

South African Journal of Science, Vol. 79, No. 11, p 459-465, November/December, 1983. 155 Ref.

Descriptors: *Soil-water-plant relationships, *Root resistance, *Plant resistance, *Soil resistance, Soil water, Plant water flow.

Resistances along the pathway of water movement from the soil through the plant to the atmosphere are of fundamental importance in soil-plant-water relations. The largest resistance to water flow in the soil-plant-atmosphere continuum is the diffusive resistance encountered in the vapor phase. In the liquid phase, the plant initially presents a greater resistance to water movement than does the soil as the soil dries out. The main plant resistance is appraisable, in the roots Root resistance is particular. as the soft direct sout. The main plant resistance is parti-tioned into radial resistance to water flow across the root to the xylem, and axial resistance to longi-tudinal water movement up the root in the xylem. Radial resistance is usually substantial relative to axial resistance. Uncertainty exists as to the main Radial resistance is usually substantial relative to axial resistance. Uncertainty exists as to the main pathway of radial flow, and also the exact location of resistance, with the endodermis considered the most likely site. Furthermore, root resistance is largest in meristematic regions and lowest in a zone of maximum absorption between the meriste-matic and suberised regions. Many chemical, phys-ical and biological factors influence root resistance to water flow. Furthermore, root resistance has to water now. Furthermore, roor restrance has been shown to change with different flow rates. Plant resistance is thus dynamic in nature and influenced by environmental conditions. There is a definite need to standardize the units used to express resistance values. The SI system using meters, seconds and pascals is suggested. (Author's bettern) abstract) W85-00216

DIFFERENCES IN WATER UPTAKE RATES OF SOYBEAN ROOTS ASSOCIATED WITH

TIME AND DEPTH, Iowa State Univ., Ames. Dept. of Agronomy. Y.-S. Jung, and H. M. Taylor. Soil Science, Vol. 137, No. 5, p 341-350, May, 1984. 5 Fig, 3 Tab, 27 Ref.

Descriptors: *Soybean, *Water uptake, *Mathematical models, Soil resistance, *Root resistance, Radial resistance, Axial resistance, Soil water, Plant water potential, Transpiration.

A mathematical model, based on the water flow equations to simulate water uptake, was developed incorporating soil, root-soil contact, and radial and axial resistances to water flow in soybean. Parameters for the model were developed from field experiments conducted during the 1979 growing eason on Ida silt loam, a loces soil, at Castana, Iowa. The specific water uptake rate decreased from 0.23 to 1 x 10 to the 4 cu cm H2O/cm root/day as the soil water became depleted in a particular layer. The average conductivity of the soil-root system decreased linearly with age of plant. The axial resistance estimated from the Poiseuille-Hagen equation was 0.0085 (bar-sec-mm to the 4). The water potential decrease along the vertical axis at the 20-cm depth was 0.0615 bar/cm when the transpiration rate was 1 cm/day. A simulation axis at the 20-cm depth was 0.0015 bar/cm when the transpiration rate was 1 cm/day. A simulation of water uptake, based on a solution of the water flow equation with a sink term and performed with the aid of a differential equation solver DGEAR, tracks the seasonal withdrawal of water in a rea-sonably accurate manner. (Moore-IVI) W85-00218

GROWIH OF ALPINE PLANTS UNDER CONTROLLED DROUGHT,
Duke Univ., Durham, NC. Dept. of Botany.
K. M. Peterson, and W. D. Billings.
Arctic and Alpine Research, Vol. 14, No. 3, p 189-194, August, 1982. 2 Tab, 20 Ref.

Descriptors: *Drought resistance, *Alpine plants, *Plant growth, Snowmelt, Water stress, Alpine regions, Habitats.

Plants of 11 alpine species (5 from the Rocky Mountains and 6 from the Sierra Nevada) were grown from seed under contrasting watering fre-quencies in controlled phytotron environments. Differences in the growth of these plants between Differences in the growth of these plants between reatments were compared to the presence or absence of meltwater in their respective habitats. In general, plants characteristic of habitats receiving meltwater from permanent or long-lasting snow-banks showed a greater reduction in growth under drought stress than plants from habitats with little meltwater moisture. Relative growth rate, net assimilation rate, leaf area duration and root-shoot ratios were calculated for each species. Plant dry weights were statistically greater in the daily water treatment than under the weekly water application for 7 of the 11 species. Total dry weight in Silene acaulis did not vary significantly between the two treatments, but its net assimilation rate was significantly higher under drought even though its leaf area duration was significantly lower. Drought had the most marked effect on Deschampsia caespitosa, a moist-site grass. (Author's abstract) W85-00235

COMPARATIVE WATER RELATIONS OF PHREATOPHYTES IN THE SONORAN DESERT OF CALIFORNIA, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

E. T. Nilsen, M. R. Sharifi, and P. W. Rundel. Ecology, Vol. 65, No. 3, p 767-778, 1984. 10 Fig, 2 Tab, 39 Ref. NSF grant 79-21971.

Descriptors: *Phreatophytes, *Drought resistance, *Sonoran Desert, *California, Shrubs, Plant water potential, Deciduous plants, Seasonal variation, Diurnal variation, Water stress, Plant physiology, Desert plants, Osmotic pressure.

The seasonal and diurnal water relations were compared among six desert phreatophytes, two evergreen shrubs, and one deciduous shrub. All species were located in one wash woodland in the Sonoran Desert of southern California. There are several mechanisms by which these phreatophytes have adapted to the desert environment. One group of winter-deciduous phreatophytes (Olneya tesota, Prosopis glandulosa, and Acacia greggii) experienced summer midday leaf water potentials below 4.0 MPa. These phreatophytes had a series of physiological mechanisms for tolerating summer water stress, including seasonal and diurnal osmoric adjustment and the maintenance of high leaf conductance at low leaf water potential. Osmotic adjustment of these three phreatophytes was simi-

lar to or greater than that of two evergreen species (Larrea tridentata and Simmondsia chinensis). Dalea spinosa, a stem-photosynthetic phreatophyte, avoided water stress by maintaining a very small leaf area. The summer-deciduous phreatophytes (Hyptis emoryi, and Chilopsis linearis) demonstrated mechanisms of drought avoidance such as change in leaf biomass and low summer leaf conductance. Little osmotic adjustment occurred in the summer-deciduous phreatophytes. The phreatophyte species studied in this investigation have evolved adaptations to water stress that are similar to those of deciduous and evergreen shrubs of the Sonoran Desert. Desert phreatophytes are a complex group of species with varied adaptive mechanisms to tolerate or avoid drought and should not be considered simply a group of speshould not be considered simply as group of spe-cies that avoid desert water stress by utilizing deep ground water unavailable to other desert species of drought tolerance and avoidance. (Author's abstract) W85-00256

FLOODING AND SO2 STRESS INTERACTION IN BETULA PAPYRIFERA AND B, NIGRA SEEDLINGS,

Cornell Univ., Ithaca, NY, Dept. of Natural Re-

R. J. Norby, and T. T. Kozlowski. Forest Science, Vol. 29, No. 4, p 739-750, 1983. 2 Fig, 3 Tab, 40 Ref.

Descriptors: *Flooding, *Sulfur dioxide, *Birch, *Seedlings, Air pollution, Plant growth, Stomatal conductance, Chlorosis, Stomatal closure, Flood-

The effects of flooding of soil for 5 weeks and fumigation of shoots with 0.35 ppm SO2 for 30 hours, alone and in combination, were studied on hours, alone and in combination, were studied on Betula papyrifera Marsh, (paper birch) and Betula nigra 1. (river birch) seedlings. B. papyrifera, an upland species, was adversely affected by flooding more severely than B. nigra, a lowland species. Symptoms of flooding injury in both species in-cluded stomatal closure, chlorosis, deterioration of root systems, and greatly reduced dry matter accu-mulation. Flooding induced formation of hypertromulation. Flooding induced formation of hypertro-phied lenticels and adventitious roots in B. nigra phied lenticels and adventitious roots in B. nigra but not B. papyrifera seedlings. Seedlings of both species recovered 1 to 2 wk after flooding ended and continued growing at a faster rate than unflooded seedlings, thereby partially or completely compensating for the growth-inhibiting effects of flooding. Fumigation with SO2 at the end of the flooding period induced partial stomatal closure, injury to leaves, and reductions in mean relative growth rates in both species. Stomatal conductance and SO2 uptake in B. nigra seedlings were reduced 40 and 45% by flooding, respectively, and consequently SO2 caused less visible injury (17 vs. 44% of leaf area) and less growth inhibition (0 vs. 26% in mean relative root growth rate) in flooded 44% of leaf area) and less growth inhibition (0 vs. 26% in mean relative root growth rate) in flooded than in unflooded seedlings. Stomatal conductance and SO2 uptake were reduced even more in flooded B. papyrifera (75 and 77%, respectively), yet flooded and unflooded seedlings were similarly affected by SO2. Flooding stress apparently affected mechanisms of pollution avoidance and pollution tolerance differently in the two species. (Author/selverice) thor's abstract) W85-00292

2J. Erosion and Sedimentation

ACCELERATED SOIL EROSION IN A KARST AREA: THE BURREN, WESTERN IRELAND, Trinity Coll., Dublin (Ireland). Dept. of Geogra-

Journal of Hydrology, Vol. 61, No. 1-3, p 113-124, February, 1983. 9 Fig. 1 Tab, 8 Ref.

Descriptors: *Karst hydrology, *Soil erosion, *Burren, *Ireland, Soil properties, Vegetation, Rocks, Glacial drift, Erosion.

The Burren is a plateau karst on the west coast of Ireland. It is characterized by thin soils, patchy vegetation and large areas of bare rock, supposedly

Group 2J-Erosion and Sedimentation

a legacy of glacial erosion. Archaeological and megacy or guaranteroston. Archaeological and palynological evidence suggest that the area was well populated and forested in prehistoric times, though now it is a marginal area agriculturally. Investigation of palesols and of karren forms on Investigation of palesols and of karren forms on ancient structures support the idea of an extensive cover of mineral soil, removed by forest clearance initiated erosion over a relatively short period of time. In the context of the Burren it seems improbable that the original forest could disappear sufficiently rapidly under natural conditions to allow unprotected soil to be washed underground in large quantities. Therefore the present day karst landscape of the Burren may represent an example of man induced destabilization of a sensitive environment. (Baker, IVI) nt. (Baker-IVI)

HISTORICAL AND PROJECTED SHORELINE CHANGES, OCEAN CITY AND NORTH ASSA-TEAGUE ISLAND, MARYLAND, Maryland Univ., College Park. Dept. of Geogra-

S. P. Leatherman.
Available from the National Technical Information
Service, Springfield, VA 22161, as PB84 180206,
Price codes: A03 in paper copy, A01 in microfiche.
Maryland Water Resources Research Center Publication No. 79, August 1983. 39 p. 20 Fig. 2 Tab,
22 Ref. OWRT Project No. A-065-MD (1), Contract/Grant No. 14-34-0001-2122.

Deacriptors: *Recession, Beaches, Coasts, *Beach erosion, Beach profiles, *Littoral drift, *Jetties, Breakwaters, Silting, Storm surges, Assateague Island, Ocean City, *Maryland.

titative analysis of historical shorelines from 1850 to 1980 indicates a prevailing trend of recession along the Maryland Atlantic Coast, which has sion along the Maryland Atlantic Coast, which has averaged 1.9 feet per year. The rate of shoreline retreat along the northern end of Assateague Island, MD, has been greatly accelerated by interruption of the net southerly littoral drift since construction of the Ocean City Inlet jetties in 1934-5. The barrier island has responded to this sediment deficiency by forming a concaval shoreline configuration and has migrated very rapidly landward along the northern end. At the present rate of migration (averaging 36 feet per year), the barrier will reach the mainland bayshore near the Ocean City airport location by the year 2000. In addition to the dissolution of the northern end of Assateague Island, Ocean City will experience increased storm surge flooding and inlet/bay siltation problems if some action is not taken to mitigate the effects of jetty emplacment and downdrift sediment starvation. ent starvation W85,00074

BOX-JENKINS TRANSFER FUNCTION MODELS APPLIED TO SUSPENDED SEDI-MENT CONCENTRATION-DISCHARGE RE LATIONSHIPS IN A PROGLACIAL STREAM, Southampton Univ. (England). Dept. of Geogra-

phy, A. M. Gurnell, and C. R. Fenn. A. Tricia and Alpine Research, Vol. 16, No. 1, p 93-106, February, 1984. 7 Fig. 5 Tab, 24 Ref.

Descriptors: *Suspended sediment, *Model studies, *Glacial streams, *de Tsidjiore Nouve, *Switzerland, Linear regression analysis, Glacial sediments, Sediment load.

Suspended sediment rating curves have provided a simple method for the interpolation and extrapolation of suspended sediment concentration and load tion of suspended sediment concentration and load in proglacial streams. The usefulness of suspended sediment rating curves is explored using observations of suspended sediment concentration and discharge from the proglacial stream of the glacier de Tsidjiore Nouve, Valais, Switzerland. A logarithmic transformation of both suspended sediment me transformation of both suspended sediment concentration and discharge was suitable for estimating suspended sediment rating curves by linear regression analysis, but in spite of lagging, differencing, and weighting the variables, a consistently good method of predicting suspended sediment concentration from discharge was not found. A major problem was serial autocorrelation in the

residuals from the sediment rating curves, and so a method placing central attention on the autocorrelation in the data series was adopted. A transfer function between the discharge and suspended sediment series was estimated. The transfer function gave by far the best forecasts of suspended sediment concentration of all the models investigated, even when it was applied to a different ablation season from that for which it was estimated. In addition, the transfer function and associated ablation season from that for which it was estimated. In addition, the transfer function and associated univariate time series models also provided information about the character of the suspended sediment and discharge series, which could be used to interpret the hydrology of the proglacial zone and the lower part of the glacier de Tsidjiore Nouve. The findings indicate that transfer functions are so superior to ordinary rating curves that they should be used whenever possible to predict suspended sediment load in proglacial streams. In the absence of a sufficiently good data base, the ordinary rating curve seems to be the second best approach of the methods investigated, but the resulting load estimates are likely to be highly erroneous. (Baker-IVI) W85-00112

CAUSES, CONSEQUENCES AND REMEDIES OF SOIL EROSION IN KENYA,

Kungliga Vetenskapsakader (Sweden). Beijerinstitutet. For primary bibliographic entry see Field 4D. W85-00129

HUDSON BAY RIVER SEDIMENTS AND RE-GIONAL GLACIATION: I. IRON AND CAR-BONATE DISPERSAL TRAINS SOUTHWEST OF HUDSON AND JAMES BAY,

Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div. J. D. Adshead.

Canadian Journal of Earth Sciences, Vol. 20, No. 2, p 290-304, February, 1983. 5 Fig, 2 Tab, 53 Ref.

Descriptors: *River sediments, *Hudson Bay, *James Bay, *Glaciation, *Iron, *Carbonates, Severn River, Winisk River, Attawapiskat River, Churchill River, Nelson River, Moose River, Albany River, Glacial drift, Fluvial sediments, Silt,

The composition of sands deposited from seven major rivers that flow into western Hudson and James Bays are described. An attempt is made to infer regional drift dispersal limits based on regional patterns of fluvial sand composition and on watershed patterns of rivers with sediment of characteristic composition. The effects of water sorting during the transition from drift to fluvial sediment ourning the transmon from entit to intuit a sediment are indicated by a higher content of total iron and carbonate minerals in the fine-grained silty sand and sandy silt samples. However, comparison of sediments of similar particle size characteristics demonstrates that there are no systematic difference in the sediment of the sedim denionstrates that there are no systemace differences in total iron content or carbonate mineralogy within localities, regardless of sampling location in river channels or off the mouths of rivers in Hudson or James Bays. Sands of the Severn, Winisk, and Attawapiskat Rivers are characterized by significantly higher calcite/dolomite ratios than the sands of the Churchill and Nelson Rivers north the sands of the Churchill and Nelson Rivers north of Cape Henrietta Maria and the Albany and Moose Rivers south of it. Calcite enrichments indicate that a distinctive carbonate dispersal train extends southwest of Cape Henrietta Maria, suggesting a dominant pattern of southwesterly ice flow in this region. Total iron oxide contents are highest for sands from rivers in the Cape Henrietta Maria area, where local averages are 2.2 to 2.7% as compared with 1.4% for the Churchill and Nelson Rivers, and 1.9% for the Moose River, north and south of the cape, respectively. The pattern suggests that a broad train of drift with higher iron content extends southwest of Cape Henrietta Maria, roughly delineated by the waternighter from content extensis southwess of Cape Henrietta Maria, roughly delineated by the water-shed of the Severn, Winisk, Attawapiskat, and Albany Rivers. The dispersal train inferred from calcite/dolomite ratios overprints part, but not all of the dispersal train inferred from the iron con-tent. (Baker-IVI) W85-00145

HUDSON BAY RIVER SEDIMENTS AND RE-GIONAL GLACIATION: II. COMPARISON OF CARBONATE MINERALOGY OF SIZE FRAC-TIONS FOR ICE MOVEMENT INFERENCE, Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div. J. D. Adshead.

Canadian Journal of Earth Sciences, Vol. 20, No. 2, p 305-312, February, 1983. 4 Fig. 1 Tab, 14 Ref.

Descriptors: *Fluvial sediments, *Glaciation, *Rivers, *Hudson Bay, *James Bay, Carbonates, Mineralogy, Ice movement, Sand, Silt, Clay, River sediments, Limestone, Glacial drift.

To study the effects of differential abrasion on fluvial sediments in the Hudson Bay area, the mineralogy of the silt and clay fractions of river muds from the west side of Hudson and James Bays is compared with the mineralogy of river sands from the same area. Regional claim coarse clay fractions parallel the regional pattern for carse silt, fine silt, and coarse clay fractions parallel the regional pattern for drift with distinctive carbonate composition extending southwest of Cape Henrietta Maria. Mineralogical results emphasize the role of common underlying factors such as source bedrock and ice dispersal patterns in influencing the distribution of carbonate minerals in glacial derivative sediments. Conversely, carbonates in river sediment of the Hudson Bay region are useful indicators of region-Conversely, carbonates in liver seatment of relient Hudson Bay region are useful indicators of regional drift dispersal and ice-flow patterns. The abundance of dolomite over calcite in coarse silt and the enrichment of calcite in fine silt may be exdance of dolomite over calcite in Coarse sitt and the enrichment of calcite in fine silt may be explained by a greater resistance to abrasion of grains of dolomite than grains of calcite after particles have been reduced to sizes lying in the coarse silt range. Clay-size particles of calcite and dolomite are among the most susceptible of sediment components to acid dissolution, but constitute 10-20% of the 0.2-2 micro m fraction of muds from the Nelson, Severn, and Attawapiskat localities. The widespread use of silt or combined silt and clay fractions for calcite and dolomite determinations in drift provenance studies is not upheld by the results of this study. Use of the sand particle size grade is advocated for studies of the carbonate mineralogy of tills or galcial derivative sediments. It is clear from the carbonate mineralogy of river sediments from the lowlands that sands reflect the composition of carbonate source rocks in the region much better than silts. (Baker-IVI)

DEPOSITION OF FINE AND COARSE SAND IN AN OPEN-WORK GRAVEL BED,

Biological Association, Ambleside Freshwater (England). P. A. Carling.

Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 2, p 263-270, February, 1984. 6 Fig, 2 Tab, 41 Ref, 1 Append.

Descriptors: *Sand, *Streambeds, *Siltation, *Sedimentation, Water pollution effects, Stream fisheries, Stream degradation, Gravel, Bed load, Suspended sediments, Deposition.

Low silt content in stream bed sediments is generally regarded as important to the survival of the young stages of salmonids. Knowledge of processes, rates, and downstream extent of siltation would be invaluable when evaluating pollution impact or gravel restoration programs. The siltation of small shallow upland streams with well-graded gravels was modeled using an experimental gravel bed in a flume with three grades of sands moving in suspension and as bedload. For low suspended concentrations (< 300 mg/L) the mean deposition rate was 1.34% of the initial gravel volume filled per hour. Deposition rates for sands 0.15-1.4 mm in diameter with suspended sediment concentrations of 38-9110 mg/L and Froude numbers in the range 0.008-1.21 Low silt content in stream bed sediments is generwith suspended sediment concentrations of 38-9110 mg/L and Froude numbers in the range 0.008-1.21 mg/L and Froude numbers in the range 0.008-1.21 were constant with respect to Froude number. For all concentrations the deposition rate was strongly linearly correlated with the suspended sediment concentration. The downstream decrease in siltation rate from a point source was a negative exponential function of distance from that source. Turbulent resuspension of sediment prevented deposi-

Chemical Processes—Group 2K

tion in a surface layer of gravel of thickness approximately equal to the mean grain size of the gravel. Hydraulic parameters, velocity, and depth in particular, act to control the downstream distribution of the sediment load rather than the overall magnitude of deposition. Mean flow data, especially where derived from velocity profile data measured in the outer boundary layer, have limited value for siltation investigations concerned with processes occurring very close to the bed. Openwork gravels will rapidly become silted in flows with low concentrations of suspended solids. Without natural disturbance of gravels by high flows, mechanical cleansing of spawning beds has limited value where sediment pollution is likely to be a recurrent problem. (Collier-IVI)

COARSE SEDIMENT YIELDS FROM THE UPPER WAIPAWA RIVER BASIN, RUAHINE

Ministry of Works and Development, Napier (New Zealand). Water and Soil Div. P. J. Grant.

Journal of Hydrology (New Zealand), Vol. 21, No. 2, p 81-97, 1982. 6 Fig, 5 Tab, 12 Ref, 1 Append.

Descriptors: *Waipawa River, *New Zealand, *Sediment yield, *Tukituki River, Erosion rates, Floods, Cyclones, Middle Stream, Smith Stream, Mangataura Stream, Flood control, Rock, Scree.

Recent aggradation of the channels of Waipawa and Tukituki Rivers in the Rustaniwha Plains area of North Island, New Zealand, has seriously reduced the protection now given by the Upper Tukituki Flood Control Scheme. Throughout the Rushine Range, the source region of Waipawa and Tukituki Rivers, the current trend of change appears to be one of increased erosion and sediment Tukituki Flood Control Scheme. Throughout the Ruahine Range, the source region of Waipawa and Tukituki Rivers, the current trend of change appears to be one of increased erosion and sediment transport. The floods resulting during cyclone Alison, March 1975, from North Branch, in the Upper Waipawa River basin, having a sediment supply area of 0.354 sq km and a drainage area of 1.6 sq km, transported more than 44,400 cu m of coarse sediment; this represents a specific yield of 28,000 cu m/sq km. A three year period prior to Alison was suitable for the accumulation of a large supply of loose rock waste and, as well as transporting this, Alison floodwater eroded much bedrock and some old scree material. The flood level produced by cyclone Alison on the Upper Waipawa River has an estimated recurrence interval of about 7.5 years leading to a minimum average annual sediment yield of 3700 cu m/sq km/a from this storm alone. When other floods are taken into account a more realistic average annual sediment yield of North Branch is estimated to be 4500 cu m/sq km/a, but this also is conservative. From this specific yield other approximate specific yields were derived for the headwater areas of: Middle Stream, 2100 cu m/sq km/a; Smith Stream, 3200 cu m/sq km/a. Compared with available values of annual erosion rate and sediment yield for geologically and physiographically similar regions in New Zealand, the coarse sediment yield from the Upper Waipawa branches of > 4500 cu m/sq km/a may be one of the highest, if not the highest, in New Zealand, (Collier-IVI)

SIMULATION OF DISPERSION OF HEAVY PARTICLES IN CONFINED TURBULENT

PARTICLES
FLOWS,
Sheffield Univ. (England). Dept. of Chemical Engineering and Fuel Technology.
R. Weber, F. Boysan, W. H. Ayers, and J.

Swithenbank.

AIChE Journal, Vol. 30, No. 3, p 490-492, May, 1984. 3 Fig, 10 Ref.

Descriptors: *Sediment transport, *Turbulent flow, *Simulation, Lagrangian method, Mathematical equations, Computer models, Particulate

The turbulent dispersion of particles is of major importance in such diverse applications as liquid fuel and coal combustion, reaction quenching, sediment transport in rivers and gas-solid separation in

cyclones. The application of a Lagrangian formu-lation to experimental situations both in pulverized coal burners and the case of particle-laden cold flow to validate the physical modelling is de-scribed in the Lagrangian approximation. flow to validate the physical modelling is de-scribed. In the Lagrangian approach a representa-tive number of individual particle trajectories are calculated within the Eulerian gas flow field, which is obtained either experimentally or through the solution of the governing equations of the gas phase complemented by a suitable turbulence model. The results of the large number of particle trajectory calculations are ensemble averaged to give the particle concentration distribution defined in the Eulerian sense. (Baker-IVI)

BRAIDED-STREAM DEPOSITION IN THE MPEMBENI RIVER, ZULULAND, Southern Sphere Mining and Development, Rand-

burg (South Africa). O. R. Dix.

South African Journal of Science, Vol. 80, No. 1, p 41-42, January, 1984. 5 Fig. 5 Ref.

Descriptors: *Braided streams, *Deposition, *Mpembeni River, *Zululand, *South Africa, Bedforms, Sandwaves, Dunes, Flooding, Velocity, Water depth, Erosion, hannel morphology.

The Mpembeni River is a perennial stream which runs east of Babanago in Zululand. It has a catchment area of 260 sq km above the reach investigated with a high proportion of grantitic and arkosic bedrock. Investigations of the area suggest the following sequence of events occurs during flooding. First, at high water, all sand and some gravel in the braided reach is transported downstream, leaving a lag of only the larger clasts. When the flow is waning, smaller clasts and sand-size sediment are deposited on the lag. Bedforms such as sandwaves and dunes probably form, depending on factors such as flow velocity and water depth. Transition from high to intermediate flow results in braiding. High-flow bedforms such as sandwaves emerge and are no longer in equilibrium in braiding. High-flow bedforms such as sand-waves emerge and are no longer in equilibrium with flow. Complex patterns of erosion and deposi-tion ensue, and the bedforms are dissected to form a series of compound bars. With further decline in discharge, water flow concentrates in a single channel with high depth to width ratio. This con-centration of flow and reduced sediment input from upstream results in greater competency. Deg-radation ensues, progressing upstream from the weir, which acts as a local base level. The effect of degradation is to reduce gradient and cause the channel to meander. These changes involve the concepts of geomorphic thresholds and complex response. (Baker-IVI)

SEDIMENTATION AND RESUSPENSION IN A NEW ENGLAND SALT MARSH, Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies. T. E. Jordan, and I. Valiela. Hydrobiologia, Vol. 98, No. 2, p 179-184, January, 1983. 5 Fig. 2 Tab, 15 Ref.

Descriptors: *Sedimentation, *Resuspension, *Great Sippewissett Salt Marsh, *Massachusetts, Salt marshes, Particulate matter, Particle size, Nitrogen, Sediment transport, Tidal effects, Mussels.

Particulate matter in a salt marsh can undergo repeated sedimentation and resuspension. Sedimentation in Great Sippewissett Salt Marsh, Massachusetts, was compared to other fluxes of particulate matter. Resuspension was calculated using measured rates of filtration and biodeposition by mussels, tidal exchange of particulate matter, and sedimentation. Sedimentation measured with sediment traps, increases with tidal amplitude in areas with fast tidal current, but is unaffected by tidal amplitude in areas with slow currents. The total sedimentation of particulate nitrogen in areas with slow tidal currents is three times as large as the gross tidal exchanges of particulate nitrogen between the marsh and coastal waters. Net tidal export of particles by the marsh suggests that Particulate matter in a salt marsh can undergo export of particles by the marsh suggests that sedimentation is more than offset by resuspension. Resuspension of fine (4-40 micro m) particles

occurs early in the flood tide in tidal creeks with occurs early in the flood tide in tidal creeks with slow currents. This resuspension does not increase with tidal amplitude, suggesting that it is not caused by tidal currents. Stirring by wind or fish, and the lifting of particles in surface films, cause resuspension in muddy areas with slow tidal currents. This resuspension results in a significant input of particles into the marsh water column, one that greatly exceeds input of particles with the tide. (Collier-IVI)

2K. Chemical Processes

HYDROLOGY AND HYDROCH MISTRY OF THE CAVES BRANCH KARST, BELIZE, McMaster Univ., Hamilton (Ontario). Dept. of Geography. For primary bibliographic entry see Field 2F. W85-00006

TRACE-ELEMENT PARTITION COEFFI-CIENTS IN THE CALCITE-WATER SYSTEM AND THEIR PALEOCLIMATIC SIGNIFI-CANCE IN CAVE STUDIES, McMaster Univ., Hamilton (Ontario). Dept. of Geary bibliographic entry see Field 2F.

EFFECTS OF GEOMORPHOLOGY AND SEA-SONALITY ON THE CHEMISTRY OF CAR-BONATE GROUNDWATER, McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W85-00019

SULFUR ISOTOPES AND HYDROCHEMICAL VARIATIONS IN SPRING WATERS OF SOUTHERN INDIANA, U.S.A., Indiana Univ. at Bloomington. Dept. of Geology. For primary bibliographic entry see Field 2F. W85-00022

QUALITY OF GROUND WATER IN SOUTH-ERN BUCHANAN COUNTY, VIRGINIA, Geological Survey, Richmond, VA. Water Re-sources Div.

Sources Div.

S. M. Rogers, and J. D. Powell.

Available from the OFSS, USGS, Box 25425, Fed.

Ctr., Denver, CO 80225. USGS Water Resources
Investigations Report 82-4022, 1983. 36 p, 24 Fig, 1

Tab, 7 Ref.

Descriptors: *Coal hydrology, *Groundwater quality, Water quality, Groundwater contamination, Buchanan County, *Virginia.

In seven small contiguous stream basins in the coal area of southwest Virginia, ground water is predominantly bicarbonate in anion composition, with calcium as the major cation in the ridges and sodium the major cation in the lower altitudes. Sulfate is the major anion in water associated with coal seams and in stream waters draining areas extensively disturbed by mining activities. Water found along a major linear feature in the Big Prater Creek valley and water from deep wells in Levisa Fork basin contain chloride as the predominant anion. Hydrogen ion activities (pH) in the ground water range from 5.2 to 8.4. Tron concentrations as high as 14,000 micrograms per liter are present in domestic wells. The chemical composition of most streams changes with diminishing discharge and at baseflow is similar to the composition of local ground water. At high flows, streams draining mined areas are enriched with sulfate. (USGS) W85-00025

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE IRONTON-GALESVILLE AQUIFER, SOUTHEAST MIN-NESOTA, Geological Survey, St. Paul, MN. Water Re-

Field 2-WATER CYCLE

Group 2K—Chemical Processes

For primary bibliographic entry see Field 4B. W85-00028

CHEMISTRY OF MONTANA SNOW PRECIPI-TATION, 1982, Montana State Univ., Bozeman. Dept. of Chemis-

G. K. Pagenkopf. Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190123, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Report No. 136, Bozeman, June 1983. 26 p. 2 Fig. 5 Tab, 13 Ref. OWRT Project No. A-138-MONT (1), Contract/Grant No. 14-34-0001-2128.

Descriptors: *Chemistry of precipitation, *Snow-fall, Acidity, Chemical analyses, Water quality, Acid streams, *Montana, Sampling, *Acid precipi-tation, *Acid snow, Contaminant transport, Acid precipitation effects, Pollutant identification.

This project investigated the chemistry of precipitation in the western mountain region of Montana. Of particular concern was the acid content of the Of particular concern was the acid content of the snowfall. Seventy-seven snow samples were collected during the winter of 1982 and analyzed for chemical constituents. Several of the samples indicated the presence of acid precipitation; however, in general the study areas were not being subjected to acid precipitation. Surface water samples were collected from twenty-eight lakes and streams. Chemical analyses of these water samples indicated that many of the lakes could be classified as moderated that the control of the collection of the collecti ately or extremely sensitive to acid precipitation, based on their respective calcium saturation index.

OXYGEN CONSUMPTION IN THE BOTTOM WATER RELATED WITH THE PRODUCTION OF SULFIDES IN THE BOTTOM SEDIMENTS.

OF SULFIDES IN THE BOTTOM SEDIMENTS, Kinki Univ., Osaka (Japan). Dept. of Fisheries. A. Kawai, and H. Maeda. Bulletin of the Japanese Society of Scientific Fish-eries, Vol. 50, No. 1, p 119-124, January, 1984. 6 Fig. 4 Tab, 19 Ref.

Descriptors: *Lake sediments, *Dissolved oxygen, *Lake Biwa, *Japan, *Sulfides, Lake sediments, Regression analysis, Seasonal variation.

The actual distribution and seasonal variation of the dissolved oxygen in the water as well as the sulfide concentration in the bottom sediment of the north and south basins of Lake Biwa were examined. Dissolved oxygen consumption due to the bottom sediment was estimated from the dissolved oxygen uptake in the bottom sediment core was measured separately from total uptake by supplementation of formalin or mercury chloride. Total dissolved oxygen consumption rates in the north and south basins averaged 0.4 g of oxygen/sg m/day and 0.02 oxygen consumption rates in the north and south basins averaged 0.4 g of oxygen/sq m/day and 0.02 g oxygen/sq m/day, respectively. Chemical oxygen uptake accounted for about 80% and 17% of the total oxygen uptake in the north and south basins. The sulfide accumulation was much higher in the north basin than in the south. In both basins the concentration of sulfide in the bottom sedimen was correlated with chemical dissolved oxygen consumption in the overlying water. Regression analysis suggests that the rate of chemical dissolved oxygen consumption in the overlying water in both basins depends mainly on the amount of sulfides in the bottom sediment. (Baker-IVI) W85-00139

CALCITE FORMATION IN CALCIUM CHI.O-

RIDE RICH WATER,
Nagoya Univ. (Japan). Water Research Inst.
C. Tomiyama, and Y. Kitano.
Japanese Journal of Limnology, Vol. 45, No. 1, p
1-5, January, 1984. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Calcite, *Chemical reactions, *Calcium chloride, *Dry Valleys, *Antarctica, *Don Juan Basin, Sediments, Carbonates, Calcium carhonate, Magnesium, Aragonite.

Calcium carbonate is contained in the sediment of the Don Juan basin, the south fork of the Wright

Valley in the Dry Valleys region of Antarctica. To clarify the calcite formation process a study was made of the crystal form of calcium carbonate made of the crystal form of calcium caronament precipitation from calcium rich solution containing magnesium ions and the transformation of arago-nite to calcite in calcium chloride type brine. The study indicates that calcite was formed in calciumstudy indicates that calcite was formed in calcium-rich solution in spite of the presence of magnesium-ions, and that aragonite was not transformed into calcite in calcium chloride rich solution containing magnesium ions. These findings suggest that calcite has been formed from the Don Juan Pond water through inorganic processes and that the past pond water contained a large amount of calcium chlo-ride and a rather small amount of magnesium ions as seen in the present pond water. (Baker-IVI) W85-00185

BEHAVIOUR OF TRACE ELEMENTS IN THE TAKAHASHI RIVER ESTUARY, JAPAN,

AAAAAAHASHI RIVER ESTUARY, JAPAN, Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.

H. Teraoka, and M. Ogawa.
Japanese Journal of Limmology, Vol. 45, No. 1, p 6-12, January, 1984. 2 Fig. 4 Tab, 18 Ref.

Descriptors: *Adsorption, *Trace elements, *Taka-hashi River Estuary, *Estuarine environment, *Japan, Lead, Copper, Zinc, Nickel, Manganese, Chromium, Cobalt, Phosphorus, Organic matter.

The concentrations and the enrichment factors for The concentrations and the enrichment factors for iron, manganese and organic matter in suspended solids were slightly higher in estuarine water than in rivers, suggesting adsorption of these trace elements on particles. In addition, concentrations of trace elements such as Pb, Cu, Zn, Ni, Mn, Cr, Co trace elements such as Pb, Cu, Zn, Ni, Mn, Cr, Co and P in suspended solids in water columns and in the sieved sediments were positively correlated with the amount of organic matter at p = 0.1%. As to trace elements dissolved in the water, the concentrations of Fe, Cu, Ni, Pb and Cr in estuarine surface waters were slightly lower than in river waters, but Mn, Ag and Zn showed the reverse tendencies. The comparison of concentrations of trace elements in the interstitial water behained from estuarine sediments with the overly-vertice. tions of trace elements in the interstitual water obtained from estuarine sediments with the overlying water indicates a characteristic increase of Mn and Co by factors of 620 and 37, respectively, and a 7.3-15 fold increase of Cr, Cu, Zn, Pb, Ag, Fe, and Ni. Almost all trace elements and organic matter that had been adsorbed is released again in the reducing environment of sediment. Owing to the positive correlation between trace elements and organic matter in the various sized sediments and the abundance of organic matter in interstitial water, organic matter may be most important for postdepositional migration of trace elements. postdepositi (Baker-IVI) W85-00186

WATER QUALITY AND ROCK WEATHERING IN THE UPPER REACHES OF THE TENRYU RIVER IN CONNECTION WITH LANDSLIDE

Miyazaki Univ. (Japan). Faculty of Engineering. S. Nakamura, M. Takemura, and Y. Kitano. Japanese Journal of Limnology, Vol.45, No. 1, p 13-25, January, 1984. 8 Fig. 3 Tab, 6 Ref.

Descriptors: *Landslides, *Weathering, *Water quality, *Tenryu River, *Japan, Chemical reactions, Bicarbonates, Calcium, Natural waters, Geo-

Natural waters in the upper reaches of the Tenryu River were analyzed in connection with landslide disasters. Landslides occurred in the limestone areas and metamorphic rock plus limestone areas where the concentrations of bicarbonate and calcium in natural waters were more than 40 mg/l and 13 mg/l, respectively. Landslides occurred in metamorphic rock plus granite areas where the concentrations of bicarbonate and calcium were more than about 25 mg/l and 8 mg/l, respectively. Landslides occurred in the granite areas where the concentrations of bicarbonate and calcium are more than about 20 mg/l and 7 mg/l, respectively. These geochemical considerations and discussion are helpful for the understanding of the chemical weathering of rocky materials and also the occur-rence of landslides. (Baker-IVI)

SHORT STUDY OF THE INFLUENCE OF A VALLEY ON THE COMPOSITION OF RAIN-

Central Electricity Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept. For primary bibliographic entry see Field 5B. W85-00238

PRECIPITATION CHEMISTRY PROBABILITY
- THE SHAPE OF THINGS TO COME.

Pack (Donald H.), McLean, VA.

Atmospheric Environment, Vol. 16, No. 5, p 1145-1157, 1982. 8 Fig. 6 Tab, 14 Ref.

Descriptors: *Chemistry of precipitation, *Probability, *Ions, Hydrogen ion concentration, Sulfates, Nitrates, Chloride, Ammonia, Calcium, Magnesium, Potassium, Temporal distribution.

Cumulative frequency distributions, presented in probability terms, were determined for the five major ions (H(+), SO4(2-), NO3(-), Cl(-), NH4(+) at five MAP3S sites and Ca(2+), Mg(2+) and K(+) for two of these locations). The sites used are: Pennsylvania State University, PA; Ithaca, NY; University of Virginia, VA; Whiteface Mountain, NY; and Champaign/Urbana, IL. Curvilinear regressions were fitted to these data. The majority of the distributions are exponential (81%) with excellent correspondence with the observations (r q = 0.90 or larger for 89% of the distributions). The remaining 19% of the data was best fitted by a power law distribution. In o case did a logarithmic or linear regression fit the data best. These power law distribution. In no case did a logarith-mic or linear regression fit the data best. These equations are directly and conveniently applicable to the design of simulated rain exposures to repro-duce the natural probability of an ecosystem re-ceiving a specified ion concentration. The analysis produced a median little affected by outliers, either real or artifacts, and so is a better statistic for use in trend analysis. If combined with flux or ridit analytrend analysis. It combined with flux or ridit analysis approaches the entire concentration distribution can be examined for temporal changes with much more opportunity for detecting subtle shifts in the chemistry. (Moore-IVI)

W85-00239

MAP3S/RAINE PRECIPITATION CHEMISTRY NETWORK: STATISTICAL OVERVIEW FOR THE PERIOD 1976-1980.

Atmospheric Environmental, Vol. 16, No. 7, p 1603-1631, 1982. 5 Fig, 11 Tab, 16 Ref, 2 Append.

scriptors: *Chemistry of precipitation, *Meteor-ogical data collections, *Statistical analysis, ological data collections, *Statistical analysis Sulfur, Sulfur dioxide, Hydrogen ion concentra-tion, Ammonia, Nitrates, Seasonal variation.

The MAPS3S/RAINE precipitation chemistry network was initiated in 1976 with the objective of creating a long-term, high-quality data base for the development of regional transport and deposition models. A basic statistical summary is presented for the the initial 3 1/2 year operating period of the MAP3S/RAINE network. The overview considers statistical features of the precipitation event data base, including temporal and variable-pair behavior and spatial (site-to-site) relationships. Seasonal variations in concentrations of the species total sulfur, SO2, free hydrogen ion and NH4(+) are easily identifiable from both event and monthly average time trend analyses. Species-pair correlaare easily identifiable from both event and monthly average time trend analyses. Species-pair correlations are generally strong and positive among the major ionic species total S, nitrate, free hydrogen and ammonium; variations from this trend at individual sites can be related to geographical location. Though reasonable coherency is exhibited in site-to-site correlation analyses, the questions of proper averaging time and network density make interpretation of spatial statistics difficult. Significant features of the data set include seasonal cycling of some species, variability of the data, and interrelationships between pollutants. There is very little

Chemical Processes—Group 2K

trend to the data, over the approximately three-year period of record. (Moore-IVI) W85-00240

FACTORS INFLUENCING TRACE METAL, SULFATE AND HYDROGEN ION CONCENTRATIONS IN RAIN, Oak Ridge National Lab., TN. Environmental Sci-

S. E. Lindhers

Atmospheric Environment, Vol. 16, No. 7, p 1701-1709, 1982. 5 Fig, 3 Tab, 36 Ref. DOE contract W-

Descriptors: *Trace metals, *Sulfates, *Hydrogen ion concentration, *Chemistry of precipitation, *Tennessee, Lead, Manganese, Zinc, Air pollution, Seasonal variation, Rainfall, Wet deposition.

Precipitation collected as wetfall-only and primarily on an event basis at a site in the Tennessee Valley is a dilute sulfuric acid solution containing trace metals whose concentrations exhibit pormal distributions. The concentrations of H(+), SO4(2-), Pb, Mn, and Zn exhibit maxima in the SO(2-), Pb, Mn, and Zn exhibit maxima in the warmer months in response to synoptic meteorologic conditions. These conditions result in elevated air concentrations during air stagnation and in generally lower rainfall amounts per event and hence less dilution of the scavenged material. Dilution is indicated by significant negative correlation coefficients between concentrations and rainfall amount, the rainfall parameter exerting the strongest influence on concentrations. Concentrations are amount, the rainfall parameter exerting the strongest influence on concentrations. Concentrations are
negatively correlated with rainfall duration and
intensity to a lesser event. The relationship between concentration and rainfall amount can be
described by a negative exponential, while that
between wet deposition and rainfall amount is approximately a 0.6-power relationship. Calculated
scavenging ratios generally increase with increasing atmospheric particle mass-median diameter of
each element and are on the order of 100 for Pb,
1000 for SO42-) and Za, and 5000 for Cd and Mn.
(Author's abstract)
W85-00241

IMPACT OF LAND-USE ON THE ACID AND TRACE ELEMENT COMPOSITION OF PRE-CIPITATION IN THE NORTH CENTRAL U.S., Minnesota Univ., Minneapolis. Dept. of Civil and

Mining Engineering.
J. D. Thornton, and S. J. Eisenreich. Atmospheric Environment, Vol. 16, No. 8, p 1945-1955, 1982. 8 Fig. 6 Tab, 43 Ref. DOE grant DE-AC02-77-EVO4327.

Descriptors: *Land use, *Chemistry of precipita-tion, *Acid rain, *Trace elements, *Minnesota, Snow, Rain, Metals, Sulfates, Nitrates, Ammonia, Hydrogen ion concentration, Prairies, Cultivated lands, Forests, Soils, Neutralization.

Event (wet-only) precipitation and snow core samples from a transect across northern Minnesota provided a means for examining the influence of land-use on the composition of wet deposition. Analyses included major cations (Al, Ca, Mg, Fe, Mn), major anions (SO4, NO3), trace metals (Cu, Cd, Pb, Cr, Ni, Zn), ammonia and pH. Soil from the prairie-agricultural area greatly influences the composition of precipitation. The effect was most noted for the major cations which had concentrations in the prairie-agricultural area up to 5 times those in the forested areas. Due to the influence of local soils in the agricultural area soil sources Event (wet-only) precipitation and snow core sam local soils in the agricultural area, soil sources seemed to mask anthropogenic contribution for SO4, NO3, and the trace metals in those areas. In SO4, NO3, and the trace metals in those areas. In the soil deficient, forested areas of northeastern Minnesota, anthropogenic sources were more important. This is due to: less exposed, erodible soil; higher local anthropogenic emissions; and closer proximity to the industrial Midwest. Soil source were significant for the major cations. Based on volume-weighted, mean concentrations of H(+), SO4(2-), and NO3(-), between 64 and 91% of the strong acid was neutralized. In the agricultural area, the extent of the neutralization of rainfall acidity was greatest and included NH4(+) (84%) and soil minerals (16%). In the forested area, the extent of acid neutralization was the least and was primarily due to NH4(+) (96%). (Moore-IVI) W85-00243

ATMOSPHERIC TRACE METALS IN THE SNOW LAYERS DEPOSITED AT THE SOUTH POLE FROM 1928 TO 1977, Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).

Atmospheric Environment, Vol. 16, No. 10, p 2451-2459, 1982. 3 Fig. 4 Tab, 35 Ref.

Descriptors: *Snow, *Antarctic, *Trace metals, *South Pole, *Air pollution, Polar regions, Sodium, Magnesium, Potassium, Calcium, Iron, Aluminum, Manganese, Lead, Cadmium, Copper, Zinc, Silver.

Zinc, Silver.

Forty-seven successive dated snow samples, covering a 50 y continuous time sequences between 1928 and 1977 with a time resolution of approximately one sample per year, have been collected using stringent contamination-free techniques from a 10 m deep pit in the clean sector at the geographic South Pole, Antarctia. They have been analysed for Na, Mg, K, Ca, Fe Al, Mn, Pb, Cd, Cu, Zn and Ag in clean room conditions by flameless atomic absorption after preconcentration. For all the elements, the concentrations observed in the most recent snow layers are comparable to the ones in the 50 y old snow layers, except for Pb, for which an increase (x 4) is observed after 1960 approximately. These data therefore confirm that the influence of global atmospheric pollution is probably still negligible in the remote areas of the southern hemisphere for the 12 measured elements, except possibly for Pb after 1960. For this last element, however, an alternative explanation of the post-1960 increase could be that the post-1960 snow layers have been contaminated by operations at Amundsen Scott station, which has been occupied since 1957. (Author's abstract)

ACIDITY OF RAIN IN EUROPE, Central Electricity Generating Board, Leather-head (England). Central Electricity Research

Labs. A. S. Kallend, A. R. W. Marsh, J. H. Pickles, and M. V. Proctor. Atmospheric Environment, Vol. 17, No. 1, p 127-137, 1981. 6 Fig. 5 Tab, 11 Ref.

Descriptors: *Acid rain, *Europe, Hydrogen ion concentration, Statistical analysis, Trends.

A detailed statistical evaluation has been made of the precipitation acidity data from the European Atmospheric Chemistry Network for the time period 1956-1976 in an attempt to establish what trends are apparent. Out of 120 sites with 5 or more years data, 29 show a significant trend of increasing annual average precipitation acidity during the period and five a decrease. For these sites substantially the same result arises for the hydrogen ion concentration calculated from ionic balance based on detailed chemical analysis of the precipitation samples. The data showed that the increased annual levels of H(+) arose from an increased number of intermittent high monthly values after about 1964 rather than a sustained high level of acidity with some months continuing to values after about 1964 rather than a sustained high monthly values after about 1964 rather than a sustained high level of acidity with some months continuing to show low values similar to those seen pre-1964. This gives rise to an apparent step-increase in annual average precipitation acidity for several of the sites at this time. Comparison of data from four adjacent Swedish sites showed that they were not well correlated suggesting that the major part of the variance was explained by local rather than regional influences. (Author's abstract)

ANALYSIS OF THE CHEMICAL PROPERTIES OF RAIN IN MINNESOTA, Minnesota Univ., St. Paul. Dept. of Plant Patholo-

gy. G. C. Pratt, M. Coscio, D. W. Gardner, B. I. Chevone, and S. V. Krupa. Atmospheric Environment, Vol. 17, No. 2, p 347-355, 1983. 3 Fig. 10 Tab, 16 Ref.

Descriptors: *Chemistry of precipitation, *Minnesota, Hydrogen ion concentration, Sulfates, Nitrates, Ammonium ion, Calcium, Magnesium, Sodium, Powerplants, Air pollution.

Individual rain event samples were collected at seven sites in central Minnesota during the summers of 1977-1980 using automatic, sequential precipitation samplers placed 3.75 m above the ground. The sites were clustered with 40 km of each other in a rural area in the vicinity of a coalburning power station. The samples were analyzed for pH; axions (ion chromatography), metallic cations (inductively coupled plasma spectrometry) and the ammonium ion (colorimetry). Spatial and temporal variations in the concentrations and deposition of chemical species in the precipitation temporal variations in the concentrations and deposition of chemical species in the precipitation were observed. No definite trends in the concentrations of the ionic components with time or location could be identified over the study period. Sulfate and nitrate were the predominant anions, and through correlation and regression analyses they appeared to be associated more with metallic cations (calcium, magnesium and sodium) and the ammonium ion than with the hydrogen ion. Concentrations of the major ionic components generally tended to decrease during rain events. No obvious pattern in ionic concentrations between the sites was observed which could be related to the point source. (Moore-IVI)

INVESTIGATION OF ACID PRECIPITATION IN QINGHAI PROVINCE, CHINA,

East-West Environment and Policy Inst., Honolu-

For primar W85-00247 ary bibliographic entry see Field 5B.

COMPLEXATION OF TRACE METALS BY ADSORBED NATURAL ORGANIC MATTER, Geological Survey, Miami, FL. Water Resources

For primary bibliographic entry see Field 5B. W85-00296

DETERMINATION OF HYDROGEN ION CON-CENTRATION IN SOFTWATER LAKES USING CARBON DIOXIDE EQUILIBRIA,

Lamont-Doherty Geological Observatory, Pali-

Saucs, N1.

A. L. Herczeg, and R. H. Hesslein.

Geochimica et Cosmochimica Acta, Vol. 48, No.
4, p 837-845, April, 1984. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Hydrogen ion concentration, *Chemical analysis, *Carbon dioxide, *Experimental Lakes Area, *Ontario, Inorganic carbon, Organic carbon, Alkalinity, Carbonates, Surface

A strategy for determining the hydrogen ion con-tent of fresh waters is proposed that involves total dissolved inorganic carbon (DIC or sigma CO2) and CO2 partial pressure (PCO2) measurements rather than pH electrode measurements. This rec-ommendation derives from discrepancies between pH and carbon dioxide equilibria measurements made on several softwater lakes at the Experimental Lakes Area, northwestern Ontario. The pH calculated from DIC, PCO2, and the first dissociacalculated from DIC, PCO2, and the first dissociation constant of carbonic acid (K1) data was consistently higher than that directly measured with a
pH electrode. Similarly, calculation of PCO2 of
surface waters from pH, DIC, and K1 data gave
values up to twice that of atmospheric saturation
despite repeated equilibrations with atmospheric
PCO2. Laboratory experiments demonstrated that
the high dissolved organic carbon content of these
waters appears to alter the electrode response
yielding pH values lower than the true values.
Furthermore, the uptake of protons by weak acid
anions appear to be the cause of the measured
difference between total (Gran) and carbonate
(DIC - dissolved CO2) alkalinity. Therefore bicarbonate ion concentration must be calculated from
the difference between the total dissolved inorganic carbon content and uncharged dissolved CO2
content. These procedures should provide more

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accurate and consistent results in the pH trend in surface waters and hence yield a solid baseline against which the effects of acid precipitation can be assessed. (Author's abstract)

COMPUTER PROGRAM FOR A TRILINEAR DIAGRAM PLOT AND ANALYSIS OF WATER MIXING SYSTEMS, Kent State Univ., OH. Dept. of Geology. For primary bibliographic entry see Field 5A. W85-00360

FATE OF ORGANIC COMPOUNDS IN MOUNTAIN STREAMS IN THE MARMOT BASIN: A PROCESS REACTOR MODEL,

Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research. S. A. Telang, and G. W. Hodgson. Hydrobiologia, Vol. 98, No. 2, p 185-191, January, 1983. 2 Fig. 1 Tab, 10 Ref.

Descriptors: *Organic compounds, *Mountain streams, *Degradation, *Marmot Basin, Humic acids, Fulvic acids, Tannins, Lignins, Hydrocar-

Clear cold mountain streams of the Marmot Creek drainage basin are surprisingly active in the condrainage basin are surprisingly active in the conversion of organic matter. A conceptual process reactor model with input/output functions was developed for the Marmot basin to evaluate the stream as a reactor and to quantify many of the processes within the process reactor of the stream. The flow of refractory organic compounds through a 2 km reach of the Marmot Creek basin showed no conversion, just simple transport from input to output, for humic and fulvic acids. Tanins and lignins, which are commonly regarded as less refractory, showed conversions. Mass balance less refractory, showed conversions. Mass balance data for the input/output flow of more labile substances-amino acids, carbohydrates, fatty acids and phenols-confirmed the processes of degradation. Further, they showed a great deal of dynamic activity in the stream that resulted in some cases in net generation of labile compounds such as hydrocarbons, i.e., where processes of generation dominated those of degradation. (Author's abstract)

DRY WEIGHT LOSS AND CHANGES IN CHEMICAL COMPOSITION OF PINE (PINUS KESIYA ROYLE) NEEDLES AND TEAK (TEC-TONA GRANDIS L.) LEAVES DURING PROC-ESSING IN A FRESHWATER LAKE,

North-Eastern Hill Univ., Shillong (India). Dept.

of botany.

B. K. Tiwari, and R. R. Mishra.

Hydrobiologia, Vol. 98, No. 3, p 249-256, February, 1983. 3 Fig, 1 Tab, 31 Ref.

Descriptors: *Decomposition, *Litter, *Pine, *Teak, *Wards Lake, *Shillong, *India, Cellulose, Hemicellulose, Lignin, Sugars, Amino acids.

The dry weight loss and chemical changes during the process of decomposition of two types of litters viz; pine (Pinus keaiya Royle) needles and teak (Tectona grandis L.) leaves have been studied in a small freshwater lake (Wards Lake, Shillong, India) using plastic net (1 mm pore size) bags. The results reveal that type of litter and depth of water were the most important factors regulating the rate of decomposition. The preparatises composition of of decomposition. The percentage composition of cellulose and hemicellulose showed little variation cellulose and hemicellulose showed little variation and only a minor fall was noted in their values towards the end of the study period. The lignin percentage increased steadily at all the stations except the deepest station. The sugar and amino acid concentration dropped appreciably during the initial phase and stabilized during later periods. The general trend of change in nitrogen percentage was initial fall-increase-fall-stabilization at a near original value. The rate of decomposition was faster when compared with similar studies in faster when compared with similar studies in Canada and Europe. (Author's abstract) W85-00411

LEAF LITTER PROCESSING IN AQUATIC SYSTEMS: A TWO VARIABLE MODEL.

Brigham Young Univ., Provo, UT. Dept. of Zoology. B. J. Hanson, K. W. Cummins, J. R. Barnes, and

M. W. Carter. Hydrobiologia, Vol. 111, No. 1, p 21-29, 1984. 2 Fig. 4 Tab, 30 Ref. DOE contract DE AT06 79EV 10004.

Descriptors: *Litter, *Mathematical models, *Decomposition, *Aquatic environment, Time, Temperature effects, Detritus.

A negative exponential model with one independent variable, days or accumulated time, was examined for adequacy as a descriptive equation for aquatic leaf litter processing. The effect of adding a second independent variable, degree days or accumulated temperature, to the model was also examined. The two variable negative exponential model was shown to have two advantages over the single variable model. The expanded model provided an adequate fit of litter processing data for more cases than the single variable model. Also, the two variable model allowed determination of rate coefficients corresponding to each temperature level of the experiment rather than assuming a single, constant rate coefficient as with the one variable model. The trends of the temperature dependent rate coefficients were useful for examining processing differences between experiments for ve exponential model with one independing processing differences between experiments for different sites and seasons. (Author's abstract) W85-00412

WATER CHEMISTRY OF THE RIVER KWAI,

THAILAND,
Tasmania Univ., Hobart (Australia), Dept. of P. A. Tyler. Hydrobiologia, Vol. 111, No. 1, p 65-73, 1984. 9 Fig. 3 Tab, 8 Ref.

Descriptors: *Water chemistry, *River Kwai, *Thailand, Bicarbonates, Limestone, Hydrogen ion concentration. Calcium.

The River Kwai (Thailand) has two branches, the large Mae Nam Kwai Yai and the smaller Mae m Kwai Noi. The water chemistry of the River Kwai Noi, its tributaries, and the neighboring Kawi Yai is shown to be dominated heavily by calcium bicarbonate. Local rainwater is relatively dilute and unbuffered with a pH close to that of dilute and unbuffered with a pH close to that of distilled water in equilibrium with air. Even during months of high rainfall, river waters are heavily dominated by alkaline earth bicarbonates, and have a consequently high pH. Dominance by calcium rather than calcium plus magnesium is to be exceted since limestone predominates in the catchment. The river is turbid but well oxygenated. It will soon be impounded by a new dam, the Khao Laem project. The dam will flood much of the upper Kwai Noi valley below Bangkhlaburi. (Moore-IVI)

2L. Estuaries

DEMOGRAPHY AND FLORA OF THE OUSE WASHES, ENGLAND,
Royal Society for the Protection of Birds, Sandy

(England).
G. J. Thomas, D. A. Allen, and M. P. B. Grose.
Biological Conservation, Vol. 21, No. 3, p 197-229,
1981. 11 Fig, 8 Tab, 21 Ref.

Descriptors: *Ouse Washes, *England, *Demography, *Vegetation, East Anglia, Marshes, Fenland, Floods, Wetlands, Peat, Drainage, Grazing, Glyceria, Aquatic plants, Aquatic weeds, Habitats.

The Ouse Washes remain as the last, large, exten-The Ouse Washes remain as the last, large, extensively flooded washland in the fenland region of East Anglia. They mainly comprise high marsh and grassland with minority areas of low marsh and open water. Their principal function remains as a storage site for excess winter flood water which restricts the agricultural use to seasonal grazing and mowing. Drainage developments have allowed about three quarters of the remaining area of washland to be converted into arable land. The

flora of the washes seems typical of fenland peat except where clay and limestone have local influences in promoting diversity. Phalaris arundinacea and Glyceris maxima predominate in the fields and the latter is the dominant emergent in the aquatic habitats. The main biotic factors diversifying the habitats and flora are pool creation, ditch clearance and cattle grazing. Although no quantitative studies were made on the response of ditch plants to different grazing pressures, the impression gained was that to check Glyceria maxima growth sufficiently the grazing densities need to be quite high. Certain infrequent species such as Potamogeton berchtoldii and P. trichoides only occurred at heavily grazed sites. This is of benefit to the breeding and wintering waterbirds. The removal of Glyceria maxima during the dredging of ditches promg anu wintering waterbirds. The removal of Glyceria maxima during the dredging of ditches produces a habitat suitable for a range of colonizing species. In addition, plant propagules which have been dormant in the mud may be brought to the surface where suitable conditions for growth may be more likely. (Baker-IVI)

TROPHIC IMPORTANCE OF SPARTINA ALTERNIFLORA PRODUCTION AND DECOMPOSITION TO THE MARCH-ESTUARINE ECOSYSTEM,

New Jersey Agricultural Experiment Station, New

A. C. Marinucci.

Biological Conservation, Vol. 22, No. 1, p 35-58, January, 1982. 2 Tab, 142 Ref.

Descriptors: *Estuarine environment, *Plant growth, *Marshes, *Spartina, *Decomposition, Gulf Coast, Coastal waters, Wetlands, Detritus, Salt marshes, Productivity, Nutrients, Tidal ef-

Current estimates of the aerial production of Spartina alterniflora on the East and Gulf Coasts of the United States and Canada range from 550 g/sq m/ United States and Canada range from 550 g/sq m/year in Myoa Scotia to 2,000 g/sq m/year in the Southern United States. Though production may vary greatly between marshes in the same geographic areas, production is higher in the low marsh where plants exist exclusively because of a variety of morphological and physiological adaptations. Application of the first order decay function to S alternifora decay data has shown that decay. to S. alterniflora decay data has shown that decay rates from litter bag studies increase as one moves southward, indicating principally the effect of mi-crobial activity on the process. Decay rates deter-mined by the harvest plot technique are more rapid than the litter bag results for the same area, likely reflecting the influence of tidal transport of litter on the observed decay rate. In many estuaries, no nutrient or energy exchanges from the marsh to adjacent estuarine waters occur, thus eliminating the salt marsh as the cause of the high overall production in the adjacent estuary. In such estu-aries an interaction between tide and water density differences recirculates nutrients and detriuts back into the estuary from coastal waters, and may thus into the estuary from coastal waters, and may thus be responsible for the high estuarine productivity. Processes in salt marshes are threatened by both wholesale destructive practices and subtle pollution. Good economic and political decisions based on the integrated nature of the salt marsh with other ecosystems is needed to preserve the amount and quality of marshlands. (Baker-IVI) W85-00117

UTILISATION ON SIX SALT

MARSHES IN NEW JERSEY, Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies. J. Burger, J. Shisler, and F. H. Lesser.

Biological Conservation, Vol. 23, , No. 3, p 187-212, July, 1982. 9 Fig, 9 Tab, 38 Ref.

Descriptors: *Species diversity, *Birds, *Salt marshes, *New Jersey, Biomass, Marsh management, Gulls, Terns, Waterfowl, Waders, Marshes, Conservation, Habitats.

Use of six salt marshes by birds was measured in New Jersey from 18 April to 18 July 1972. In all, 2 impoundments, 2 ditched marshes, and 2 natural

Estuaries—Group 2L

salt marshes were studied in terms of species diversity, numbers of individuals and biomass. Seventy-eight species of birds were noted in all six marshes, but not every species occurred in each marsh. Species diversity was highest on the impoundments, intermediate on the ditched marshes, and lowest in the natural marshes. Species diversity and the number of individuals were directly related to the amount of open surface area. The traditional species typical of salt marshes on the East Coast of North America occurred primarily in the natural salt marshes and were absent from the impoundments. Red winged blackbirds and swallows were the most numerous species, followed by gulls and terns. The impoundments had over five times as many individuals as the natural marshes. Waterfowl, gulls, terns and waders accounted for over 90% of the cumulative biomass in the six marshes, with waterfowl contributing over 50%. Impoundments clearly support the largest biomass, number for exercized individuals. with waterfowl contributing over 50%. Impound-ments clearly support the largest biomass, number of species and individuals, and are used extensively by migrant waterfowl and shorebirds. Impound-ments can be created where open water areas have disappeared, creating habitats for migrants. It is equally important to preserve natural salt marshes so that the species which nest exclusively in these habitats can continue to do so. The importance of the natural salt marshe seconstem and its attendant habitats can continue to do so. The importance of the natural salt marsh ecosystem and its attendant species should not be under valued because of the higher numbers which impoundments, stop-ditch marshes and other managed areas can support. Bird species using managed areas can use a wider variety of habitats while the typical salt marsh species are limited to large expanses of relatively undisturbed salt marshes. (Baker-IVI) W85-00120

ECOLOGICAL SURVEY OF STANDING WATERS IN NORTH WEST AFRICA: I. RAPID

SURVEY AND CLASSIFICATION, N. C. Morgan, and V. Boy. Biological Conservation, Vol. 24, No. 1, p 5-44, September, 1982. 8 Fig. 5 Tab, 34 Ref.

Descriptors: *Natural habitats, *Standing waters, *Classification, *Algeria, *Morocco, *Tunisia, Wetlands, Mediterranean, Macrophytes, Invertebrates, Waterfowl, Physical properties, Zooplankton, Conservation.

A simple survey technique was used for covering a broad range of taxa to obtain a rapid assessment of the conservation value of wetlands and open waters around the Mediterranean. The method was employed in Tunisia, Algeria and Morocco and the possibility of using the data to construct a classification of North African standing waters was investigated. It was divided into four sets of data (physical, macrophytes, invertebrates and winter counts of waterflow) and cluster analyses were carried out on these. An analysis of the levels of relationship between all sites, obtained from the different cluster analyses, was then performed to combine the results and to construct natural classes. The existence of these classes was confirmed by ordination analyses. Whereas physical and botanical data tion analyses. Whereas physical and botanical data alone can be used to construct a simple hierarchi-cal classification of sites, the classification becomes more realistic in terms of the overall conservation value if faunal data are included. Zooplankton are especially valuable as indicators of habitat conditions but the state of the conditions but the state of the s especially variable as indicators of laboral condi-tions but other invertebrate groups can be of value, particularly in relation to sites with varying salini-ty. A classification constructed in this way related to all features of the sites is useful for obtaining an overall assessment of the conservation value of the waterbody. The classification aids the process at the local, national, and international levels when selecting sites to be used as natural reserves.
(Baker-IVI)
W85-00121

VEGETATION CHANGES AND WATER CATCHMENT IN A DUTCH COASTAL DUNE

AREA,
Dune Water Works of The Hague (Netherlands). Biological Conservation, Vol. 24, No. 4, p 305-316, December, 1982. 3 Fig. 5 Tab, 51 Ref.

Descriptors: *Dunes, *Vegetation, *Netherlands, *Catchment areas, *Water table, Infiltration, Nu-

trients, Catchment areas, Artificial recharge, Groundwater recharge, Water management, Plan-ning, Decision making, Eutrophication.

Studies on vegetation and landscape changes resulting from water catchment in Dutch coastal dunes are briefly reviewed and discussed with special reference to Meijendel, an important catchment area near the city of The Hague. The water works mainly concerns the extraction and artificial replenishment of groundwater. The main ecological impacts involve lowering of the groundwater replenishment of groundwater. The main ecological impacts involve lowering of the groundwater table after extraction and, after replenishment, the establishment of an unnatural groundwater table and eutrophication. Main vegetation changes include drying out of the dune wetlands, and, after replenishment, increased nitrophilous herb cover associated with a decrease in plant species diversity and life form diversity. Options for management of the area are simed largely at requiring the nutriof the area are aimed largely at reducing the nutri-ent load caused by the infiltration water and at a regeneration of dune slack communities. This could be achieved by cropping the vegetation, improving the quality of infiltration water, estab-lishing natural fluctuations of the water table and also be seducing the pass of surface infiltration. also be reducing the area of surface infiltration. Long-term observation of permanent plots are central to all these needs. The use of air photos is an important aid for the study of vegetation changes under similar conditions. (Baker-IVI) W85-00124

DEVELOPMENT OF LIQUID AND SOLID DISCHARGES OF A SUB-BOREAL ESTUARY: THE ST-JEAN RIVER, QUEBEC (NORTH COAST OF THE GULF OF ST-LAWRENCE) (EVOLUTION DU DEBIT LIQUIDE ET DE LA CHARGE SOLIDE D'UN ESTUARIE SUB-BOREAL: RIVERE ST-JEAN, QUEBEC (COTE NORD DU GOLFE DU ST-LAURENT), Quebec Univ., Rimouski. Dept. of Oceanography. D. Cataliotti-Valdina, and B. F. Long. Canadian Journal of Earth Sciences, Vol. 20, No. 2, p 184-194, February, 1983. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Hydrodynamics, *St. Jean River, *Quebec, *Estuaries, *Suspended solids, Flow discharge, Fluvial sediments, Subboreal estuaries, Flood flow, Low flow, Saline water intrusion.

An evaluation was made of the hydrodynamics of the St. Jean River estuary. Particular attention was paid to the flow dynamics and the mixing mecha-nisms which were studied for fluvial water-marine water. Two series of measurements were made on water. Two series of measurements were made on the solid and liquid discharges. The first took place during the spring flood of May 1980; the second in conditions of lowest level spring tide in August 1980. The average stream discharge is 1035 cu m/s during floods and 85 cu m/s at periods of lowest water level. When the stream discharge exceed 160 cu m/s, the wedge of salt water is pushed out of the estuary and no expresed current see proceed. of the estuary and no reversed currents are present. There is only a reduction of current velocity at the mouth of the river. Solid particles in suspension may vary in amount from 96 mg/L during floods to 4.6 mg/L for lowest water levels. In the former case about 65-95% of the solid suspension is mineral matter, and in the latter about 58% is mineral matter. The general behavior of the St. Jean River estuary suggests a new type of environment, the subboreal estuary. (Baker-IVI)

HUDSON BAY RIVER SEDIMENTS AND RE-GIONAL GLACIATION: II. COMPARISON OF CARBONATE MINERALOGY OF SIZE FRAC TIONS FOR ICE MOVEMENT INFERENCE, Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div. For primary bibliographic entry see Field 2J. W85-00146

FLUCTUATION OF THE GROUNDWATER LEVEL AND FRESH-SALT WATER INTERFACE IN RESPONSE TO THE TIDE (IN JAPA-NESE), Ehime Univ., Matsuyama (Japan). Dept. of Ap-

plied Physics.
For primary bibliographic entry see Field 2F.
W85-00192

MISSISSIPPI DELTAIC WETLAND SURVIV-AL: SÉDIMENTATION VERSUS COASTAL SUBMERGENCE,

Louisiana State Univ., Baton Rouge. Center for **Energy Studies.**

R. H. Baumann, J. W. Day, Jr., and C. A. Miller. Science, Vol. 224, No. 4658, p 1093-1095, June, 1984. 2 Tab, 21 Ref.

Descriptors: *Mississippi, *Wetlands, *Deltas, *Sedimentation, *Submergence, Batarataria Bay, Fourleague Bay, Marshes, Storms, Floods, Accretion, Sea level, Aggradation.

The Mississippi deltaic plain is a complex mosaic of delta lobes in various stages of a progradation-deterioration cycle, with most lobes presently reflecting some stage of deterioration. A study of sedimentation was conducted in the marshes surrounding Barataria Bay and Fourleague Bay: Baratarataria Bay is an interdistributary basin, and Fourleague Bay is an estuary dominated by the Atchafalaya River, an active Mississippi River distributory. Seasonal sedimentation, measured with the aid of artificial marker horizons, was markedly different in deteriorating as compared with stable different in deteriorating as compared with stable the aid of artificial marker horizons, was markedly different in deteriorating as compared with stable marshes in the Mississippi River deltaic plain. Deteriorating marshes receive most sediment during storm events, whereas stable marshes receive substantial amounts of sediments during the spring river flood. The deteriorating marshes are accreting at a faster rate (1.5 cm/yr at streamside, 0.9 cm/yr at inland areas) than the stable marshes (1.3 cm/yr at streamside, 0.6 cm/yr at inland areas). Relative to local apparent sea-level rise as measured by tide gauges in each area, the deteriorating marshes are not maintaining their intertidal elevation as well as the stable marshes. It is important to consider accretion relative to submergence. (Moore-IVI) w85-00221 W85-00221

RESPONSE OF PLANT SPECIES TO BURIAL IN THREE TYPES OF ALASKAN WETLANDS, Iowa State Univ., Ames. Dept. of Botany. A. G. van der Valk, S. D. Swanson, and R. F. Nuss.

Canadian Journal of Botany, Vol. 61, No. 4, p 1150-1164, April, 1983. 3 Fig, 7 Tab, 14 Ref, 1 Append. EPA grant R805837010.

Descriptors: *Wetlands, *Burial, *Plants, *Alaska, *Flooding, Plant growth, Carex, Equisetum, Alpine zone, Coastal region, Lowlands, Species composition, Sediments, Seasonal flooding.

At 15 freshwater lowland, 7 coastal, and 6 alpine sites, a burial experiment was set up with four treatments (0, 5, 10, or 15 cm of sediment). Species in alpine wetlands were damaged most by burial and their average shoot density in the 5-, 10-, and 15-cm treatments was reduced 35, 72, and 93% in 1070 act 12 % 54 med 19 (iii. ii) 1090. presentically In 13-cm treatments was reduced 33, 72, and 35% in 1979 and 28, 54, and 81% in 1980, respectively. In coastal wetlands, the average shoot density was 33, 65, and 76% lower in 1979 and 21, 37, and 53% in 1980 in the 5-, 10-, and 15-cm treatments. Species in freshwater lowland wetlands were the least in freshwater lowland wetlands were the least damaged by burial: average shoot density was 17, 33, and 47% lower in 1979 and 10, 7, and 39% lower in 1980 in the 5, 10, and 15-cm treatments. The responses of three common species (Carex aquatilis, Carex lyngbyaei, and Equisetum fluviatile) to burial varied from site to site. For example, Equisetum fluviatile responded to burial with a significant increase in shoot density at two permanently flooded sites and with no changes in shoot significant increase in shoot density at two permanently flooded sites and with no change in shoot density or with a significant decrease in shoot density at sites flooded seasonally. Only eight species at five sites (mostly alpine sites) were eradicated and only in the 10- and (or) 15-cm treatments at any site. In seed traps in 1979 an average of 2.7, 3.6, and 5.9 species became established at alpine, coastal, and freshwater lowland sites, respectively. In 1980, there were 1.2, 4.1, and 7.3 species, on the average represented in the seed traps in these three types of wetlands. Average seedling density was lowest in the alpine seed traps (6/sq m in 1979 and 7/sq m in 1980) and highest in coastal wetlands (362/sq m in 1970 and 270/sq m in 1980). In freshwater lowland wetlands those with permanent standing water averaged 2.2 and 3.0 species in their

Group 2L—Estuaries

seed traps in 1979 and 1980, respectively, while those only seasonally flooded averaged 8.8 species in 1979 and 9.0 in 1980. Permanently flooded freshwater lowland wetlands had 7 seedlings/sq m in 1979 and 25 in 1980, while those flooded seasonally had 122 seedlings/sq m in 1979 and 69 in 1980. On the average, slightly more than 40% of the taxa in the seed traps at a site in 1980 were taxa that had not been present in 1979, and slightly less than 40% of the taxa present in 1979 were not present in the seed traps at the same site in 1980. Only a few individuals of four species present in the seed traps of coastal wetlands in 1979 were still present in 1980. (Author's abstract) 1980. (Author's abstract) W85-00248

STATIC AND DYNAMIC ASPECTS OF NITRO-GEN CYCLING IN THE SALT MARSH GRA-MINOID SPARTINA ALTERNIFLORA, Georgia Univ., Sapelo Island. Marine Inst. C. S. Hopkinson, and J. P. Schubauer. Ecology, Vol. 65, No. 3, p 961-969, 1984. 4 Fig, 1 Tab, 54 Ref. EPA contract R 806728020.

Descriptors: *Cycling nutrients, *Salt marshes, *Nitrogen, *Spartina, *Georgia, Primary productivity, Seasonal variation, Plant growth, Leaching, Detritus, Limiting nutrients, Uptake, Transloca-

Processes of nitrogen cycling including root uptake, translocation, leaching, detrital incorporation, and overwinter storage were determined for a medium-height form of Spartina alterniflora in Georgia, USA. Mean concentration of total N in live above- and belowground plant tissues was 0.60% of dry mass. Aboveground concentrations (1.05%) were more than twice the belowground N concentrations. The seasonal patterns of nitrogen concentrations were similar for aerial and subaerial Spartina tissues with maxima observed between December and May. Concentrations were highest December and May. Concentrations were highest in short, young stems and decreased as plants matured, senesced, and died. Seasonal patterns of nitrogen accumulation were out of phase for aerial and subaerial tissues. Maximum accumulation was in midsummer for aboveground plant parts and in late winter for belowground tissue. During winter > 83% of total plant N was in roots and rhizomes. During spring, there was a large net transfer of N from belowground storage to aerial tissues; about 70% of total nitrogen was in aboveground plant parts by May. A nitrogen budget for Spartina alterniflora was constructed by combining organic parts by May. A nitrogen budget for Spartina alterniflora was constructed by combining organic productivity rates with nitrogen concentrations in plant tissues. Total uptake of N by roots was 34.8 g/sq m/yr. Of this, 43% was lost by death or leaching from aboveground plant parts, while the rest was lost by death of roots and rhizomes. Total transfer of N from below- to aboveground tissues was 33.0 g/sq m/yr, 46% of which was new nitrogen taken up from the soil. Of the N transferred aboveground, 14.4 g was lost to detritus upon culm death, 0.7 g was leached from the living culm, and 17.9 g was translocated from senescing upon culm death, 0.7 g was leached from the living culm, and 17.9 g was translocated from senescing leaves to rhizomes for storage or immediate transfer to actively growing shoots. A large percentage of the total flux into and out of leaves occurred during the period of active growth. The high degree of N conservation in Spartina, low leachability, and retrection from servers times active. bility, and retraction from senescent tissue are consistent with the idea that primary productivity in salt marshes is nitrogen limited. (Author's abstract)

BEHAVIOUR OF IRON, MANGANESE, PHOS-PHATE AND HUMIC ACID DURING MIXING IN A DELAWARE SALT MARSH CREEK, Delaware Univ., Newark. Coll. of Marine Studies. K. W. Eastman, and T. M. Church. Estuarine, Coastal and Shelf Science, Vol. 18, No. 4, p 447-458, April, 1984. 7 Fig. 3 Tab, 26 Ref. NSF grants OCE-7720770, 7920893, 8201056.

Descriptors: *Salt marshes, *Delaware, *Mixing, *Iron, *Phosphates, *Humic acid, Salinity, Geochemistry, Sediments, Resuspension, Flocculation,

The mixing behavior of iron, manganese, phosphate and humic acid in a Delaware salt marsh

creek was studied using field data, laboratory mixing experiments, and geochemical mass balance equations. Property-salinity diagrams for field data indicated that the removal of iron is 56-70% in the indicated that the removal of from is 30-70% in the 0-10 0/00 salinity range. A proposed mechanism of removal is the floculation of colloidal iron, perhaps with humic acid. Phosphate, however, undergoes 195% addition in the same low salinity region, which may be due to release of phosphate from resuspended sediments. Dissolved manganese is conserved, as is humic acid throughout the salt sees having some Within the uncertainty of the is conserved, as is humic acid throughout the salt marsh mixing zone. Within the uncertainty of the data the maximum possible removal of humic acid is 23%. Laboratory mixing experiments that simulated salt marsh mixing along the same salinity gradient as observed in the field (5-25 0/00) showed only small-scale additions and removals compared to the field results. Such small-scale changes occurred largely at salinities > 10 0/00 in the beloeved expressers whereaver the control of the salest statement of the salest salest statement of the salest salest statement of the salest statement of the salest the laboratory experiments, whereas most removals and additions occurred at salinities < 10 0/00 in the field. Mixing studies also showed little difference between prefiltered and unfiltered mixes. The studies suggest that simple mixing of salt marsh waters, with or without suspended material, does not strongly influence the observed behavior of dissolved constituents in salt marshes, and that other processes (e.g. sediment or intertidal ex-change) must dominate their behavior. (Author's W85-00290

EXPERIMENTAL STUDY OF THE STRUC-TURE OF A FRESHWATER-SALTWATER IN-TERFACIAL MIXING (ETUDE EXPERIMEN-TALE DU MELANGE A L'INTERFACE EAU-SAUMURE).

Hydraulics Research Station, Wallingford (Eng-

H. O. Anwar, and J. A. Weller. Houille Blanche, Vol. 36, No. 6, p 405-412, 1981. 9 Fig, 3 Tab, 37 Ref.

*Saline-freshwater *Mixing, *Cooling water, Entrainment, Estuaries, Heated water, Thermal pollution, Saline water, Thermal discharge, Path of pollutants, Turbulence,

Freshwater was released experimentally from a wide channel onto the surface of stationary saltwater (density 1025 kg/cu m) in a wide deep flume. This type of flow can be observed when heated cooling water is discharged from a power station horizontally onto the surface of a lake or station horizontally onto the surface of a lake or reservoir, or in an estuary where the outflow of freshwater mixes with underlying saltwater (a saline wedge). Experimental cases were studied in which the densimetric Froude number was low, varying between 0.5 and 2, and the depth of freshwater was relatively large, varying between 0.08 m to 0.12 m. The features of the model are similar to a density zone model and consists of three zones: a density zone model and consists of three zones: the entrainment zone, the roller region, and the zone of homogenous flow. Mean velocity profile measurements were made dimensionless by taking the maximum velocity occuring at the free surface as a velocity and the depth as a length scale. There was a general movement in the saltwater flume in was a general movement in the saltwater flume in the mean flow direction. A roller region appeared when Fr > 0.8 and it disappeared when Fr < 0.8; in this case, the flow of the surface layer behaved much like a flooded density jump. The turbulence intensity, being small in the major part of the surface layer, increased rapidly towards the interface behaving much like a two-dimensional channel flow; the turbulence intensity increased as the nel flow; the turbulence intensity increased as the Reynolds number decreased. There was a rise in Reynolds number decreased. There was a rise in water level immediately downstream from the freshwater inlet mainly due to an increase in potential energy caused by the mixing process in the entrainment zone. The salinity measurements for all values of Fr showed that the salt concentration near the surface was very small. The measured coefficient of entrainment was related to the Richardson number. (Collier-IVI) W85-00387

SEDIMENTATION AND RESUSPENSION IN A NEW ENGLAND SALT MARSH, Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.

For primary bibliographic entry see Field 2J. W85-00405

PLANT AND ANIMAL COMMUNITIES IN BRACKISH SUPRA-LITTORAL POOLS ('DOBBEN') IN THE NORTHERN PART OF

Katholieke Univ. Nijmegen (Netherlands). W. van Vierssen, and J. T. A. Verhoeven. Hydrobiologia, Vol. 98, No. 3, p 203-221, February, 1983. 9 Fig. 5 Tab, 20 Ref.

Descriptors: *Brackish water, *Aquatic plants, *Aquatic animals, *Netherlands, Chlorinity, Water level fluctuations, Salt marshes, Vegetation.

During summer 1977, 50 supra-littoral pools situated on salt marshes outside the seawalls bordering the Waddenzee (Netherlands) were studied. Most of them were constructed at the turn of the centuof them were constructed at the turn of the century, to supply the cattle grazing the marshes with fresh (rain) water. When the salinity in a pool becomes elevated, the farmers empty that particular reservoir and refill it. As a consequence, the environments are very dynamic and unstable. Only a quatic macrophyte species were present in the pools. The three most frequently occurring macrophytes display distinct differences with respect to their chlorinity tolerances. Ranunculus baudotii is apparently not as salt tolerant as Potamogeton their chlorinity tolerances. Ranunculus baudotii is apparently not as salt tolerant as Potamogeton pectinatus and Zannichellia pedunculata. The growth of macrophytes in many pools may be suppressed by dense phytoplankton populations, probably due to high nutrient concentration in the water. The macrofauna was studied semi-quantitatively. The aquatic Coleoptera had the greatest diversity (24 species). A distinct relationship between the number of Coleoptera species and the percentage of macrophyte coverage was found. The distribution patterns of the most frequent species with respect to chlorinity categories are shown in histograms. Twelve species of aquatic cies with respect to chlorinity categories are shown in histograms. Twelve species of aquatic Heteroptera were collected. Vegetation cover and chlorinity influence the distribution of the Heter-optera. Less important macrofaunal groups (the Crustacea, Mollusca and Odonata) occurred in low species numbers. (Moore-IVI) W85-00408

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

MATHEMATICAL MODEL OF A MECHANI-CAL-VAPOR COMPRESSION EVAPORATOR, APPLICATION TO THE PRODUCTION OF FRESHWATER BY SEAWATER DESALINA-TION; PART II - NUMERICAL EXPLOITA-TION

D. Aussenac, M. Enjalbert, and S. Domenech.
Desalination, Vol. 49, No. 2, p 117-139, February, 1984. 6 Fig.

Descriptors: *Desalination, *Mathematical models, Vapor compression evaporator, Simulation, Seawater, Mathematical equations.

The performance simulation model of the vapor compression evaporator-condenser previously presented involves an algebraic system of 265 unknowns and 215 equations. This system has to be solved by an iterative numerical algorithm due to the non-linearity of some of the equations. Because these equations come from a modular simulation of the plant the overall system of equations, can be these equations come from a modular simulation of the plant, the overall system of equations can be broken down into a number of subsystems, includ-ing a reduced number of equations describing the behavior of the module. These subsystems are unique in that they can be solved by a single-variable iteration method. Inside the loop, the system is solved sequentially. The general means of solution is simplified and represents a remarkabley convenient procedure. The model was tested using data from 27 experiments on a prototype plant. The study revealed three parameters of prime im-

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

portance: the pressure inside the evaporator-condenser, the seawater sprinkling solution flowrate of the evaporator-bundle, and the seawater temperature at the inlet of the evaporating cell. From information on the performance and the results of the experimental tests, an attempt was made to develop a complete model which best describes the plant. In spite of problems encountered during the model identification due to the lack of some experimental data and to the spread of the experimental values, the model describes the overall preformance of the plant in a reasonable way. It was possible to use it in order to study the influence of the main parameters. (Moore-IVI)

MICROPROCESSOR-BASED DATA MONITORING AND CONTROL SYSTEM FOR A CONTINUOUS ION EXCHANGE PLANT, Cape Town Univ. (South Africa). Dept. of Chemical Engineering. E. W. Randall.

Desalination, Vol. 49, No. 2, p 169-184, February, 1984. 6 Fig. 1 Tab. 4 Ref.

Descriptors: *Desalination, *Continuous ion exchange, *Monitoring, *Process control, Automation, Microprocessors, Hydrogen ion concentration, Conductivity, Water quality control, Costs.

A microprocessor system was developed for data logging and control of product water quality in a continuous ion exchange desalination pilot plant. The format used for the program structure allows dynamic interaction with the system, via interrupts, and is likely to be generally applicable to microprocessor control software. pH and conductivity measurements were used in the calculation of column cycle times. Establishing of trends in the measured parameters, before initiating control action, resulted in a stable system. The control action, resulted in a stable system. The control action ensures the minimum consumption of regenerant chemicals which is the single most important factor in the running costs of an ion exchange plant. (Author's abstract) A microprocessor system was developed for data

3B. Water Yield Improvement

WATER RESOURCES APPRAISAL OF THE COLLEGE OF THE VIRGIN ISLANDS AREA. ST. THOMAS,

Caribbean Research Inst., St. Thomas, VI. For primary bibliographic entry see Field 6B. W85-00066

OPTIMIZATION OF THE FILLING AND DRAWDOWN REGIMES OF A REGULATING RESERVOIR OF THE KUBAN' CASCADE, A. F. Fedosyuk, I. L. Krasnik, and A. B.

Kaganovich

Hydrotechnical Construction, Vol. 16, No. 8, p 470-474, August, 1982. 2 Fig. 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 50-53, August, 1982.

Descriptors: *Optimization, *Hydroelectric power, *Kuban River, Powerplants, Efficiency, Reservoirs, Drawdown, Streamflow, Seasonal variation, Floods, Runoff.

The efficiency of using the energy of the water resources of the Kuban River by the hydroelectric stations of the Kuban cascade located on the route of the Great Stavropol Canal in many respects depends on the selection of the filling and drawdown regimes of the Kuban reservoir located at the head of the canal and providing seasonal streamflow regulation. A method is introduced to optimize the filling of the Great regulating reservoir which makes it possible to increase the efficiency of using the flood, which provides additional electric energy production. Optimization of the ciency of using the Hood, which provides addition-al electric energy production. Optimization of the discharges along the Great Stavropol Canal on the basis of the criterion of minimum specific dis-charges of hydrostations of the cascade and ap-proximation of the regime of the hydrostations to these conditions additionally increase the effective ness of using the stream. The conduction of analo-

gous hydropower calculations can be useful in other power systems and cacades of hydroelectric stations. (Baker-IVI) W85-00485

3C. Use Of Water Of Impaired Quality

WATER QUALITY AND STOCKING DENSITY AS STRESSORS OF CHANNEL CATFISH (IC-TALURUS PUNCTATUS RAF.), Hamburg Univ. (Germany, F.R.). Inst. fuer Hy-drobiologie und Fischereiwissenschaft. For primary bibliographic entry see Field 3F. W85-00234

3F. Conservation In Agriculture

HYDROLOGIC CONDITIONS IN THE WHEATLAND FLATS AREA, PLATTE COUNTY, WYOMING, Geological Survey, Cheyenne, WY. Water Resources Div. For primary bibliographic entry see Field 4B. W85-00031

WATER QUALITY AND STOCKING DENSITY AS STRESSORS OF CHANNEL CATFISH (ICTALURUS PUNCTATUS RAF.), Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft. H. Klinger, H. Delventhal, and V. Hilge. Aquaculture, Vol. 30, No. 1-4, p 263-272, January, 1983. 5 Tab, 32 Ref.

Descriptors: *Water quality, *Catfish, *Water reuse, *Recirculated water, Stocking density, Blood, Physiology, Fish, Stress, Aquaculture.

Blood, Physiology, Fish, Stress, Aquaculture.

The influences of heated recirculated water and well water on three stocking densities of channel catfish (Ictalurus punctatus Raf) were compared, based on several physiological and hematological parameters. Controls were kept in well water only. The leukocyte count of fish kept in well water generally decreased, and their thrombocyte, lymphocyte and granulocyte counts were lower at higher stocking densities. In addition, a slight hemoconcentration was observed. The fish kept in recirculated water showed a decrease only in thrombocyte count. Plasma cortisol and blood glucose did not change and in all groups were at a level characteristic of resting fish. In contrast, the blood lactate levels were always high. This may have been caused by the anesthetization. The alterations found are regarded as symptoms of the 'general adaptation syndrome' induced by the stocking rates. High lymphocyte and granulocyte counts among the fish in reused water are signs of local adaptations to reduced water quality. (Author's abstract)

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

CONVEYANCE CHARACTERISTICS OF THE NUECES RIVER, COTULLA TO SIMMONS, Geological Survey, Austin, TX. Water Resources

Div. B. C. Massey, and W. E. Reeves.
A vailable from the OFSS, USGS, Box 25425, Federal Ctr., Denver, CO 80225. USGS Water Resources Investigations Report 83-4004, 1983. 39 p, 21 Fig, 2 Tab, 9 Ref.

Descriptors: *Water conveyance, *Water loss, *Water management, *Nueces River, Cotulla, Simmons, *Texas.

Analysis of discharge hydrographs for streamflow-gaging stations on the Nucces River at Cotulla, Tilden, and Simmons indicate that significant water losses occur along the 108-mile reach from Cotulla to Simmon during storm-runoff periods. Computed losses along the 83-mile reach from Cotulla to Tilden for 15 storm periods range from 32 to 59 percent of the total runoff volume passing the Cotulla gage. For six storm periods that occurred while the gage at Simmons was in operation, computed losses from Cotulla to Simmons averaged 48 percent of the storm runoff passing the Cotulla gage. Estimates of total-annual losses were made with the aid of a regression model developed to relate monthly rainfall totals to monthly runoff. Total annual water losses, estimated with the aid of the regression model, ranged from 46,000 acre-feet during 1969 to 368,500 acre-feet during 1967, and averaged about 174,000 acre-feet for 1966-77. (USGS) W85-00033

ASSESSMENT OF TIME SERIES AS A METH-ODOLOGY TO QUANTIFY IRRIGATION RETURN FLOWS,

Montana State Univ., Bozeman. Dept. of Civil

M. E. Nicklin, and R. L. Brustkern. M. E. Nickin, and R. L. Brustkern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190149, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Report No. 137, Bozeman, June 1983. 40 p. 11 Fig. 3 Tab, 5 Ref. OWRT Project No. A-136-MONT (1), Contract/Grant No. 14-34-0001-2128.

Descriptors: *Statistical methods, *Time series analysis, Irrigation water, Return flow, Diversion loss return, *Montana, *Irrigation return flows, Return flow quantification, Data requirements, Beaverhead River.

A mathematical technique known as time series analysis was tested as a potential method for return flow quantification. The time series approach for characterizing irrigation return flows offers the advantage of reduced data requirements when compared to finite difference and finite element numerical procedures. Much of the data required for time series analysis is routinely collected. Streamflow records, in particular, are available at numerous locations and constitute a generally reliable network of time series observations. A reach of the Beaverhead River near Dillon. Montana. of the Beaverhead River near Dillon, Montana, was selected for this study. Groundwater return flow is the major component of return flow to the Beaverhead River during the irrigation season. Beavernear River during the irrigation season. The time delay for particular diversions depends upon the application timing, point of application, local aquifer properties, etc. The mean aggregate time delay between diversion and return was calculated as 61 days for the years of 1966 through 1975. Time series analysis was moderately success. 1975. Time series analysis was moderately successful as a tool for quantifying the irrigation return flows at the study site. Although the concept of time series analysis is sound, effective application of the concept was hampered by the incompleteness of the diversion records at the Beaverhead W85-00071

3

INFLUENCE OF SEDIMENT TYPES ON THE SORPTION OF ENDOTHALL, North Texas State Univ., Denton, Inst. of Applied

Sciences. K. H. Reinert, and J. H. Rodgers, Jr. Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 5, p 557-564, April, 1984. 1 Fig. 5 Tab, 18 Ref.

Descriptors: *Sediments, *Sorption, *Endothall, *Herbicides, *Pat Mayse Lake, *Roselawn Cemetery Pond, *Texas, Aquatic weeds, Weed control, Carbon, Clay, Sand, Herbicides, Fate of pollutants.

Predicting the fate of chemicals using mathematical models requires accurate data derived from laboratory measurements of rate coefficients for the controlling processes. Absorption protocol for the determination of sorption partition coefficients

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was applied to two different water sediment sys-tems containing endothall. Endothall is a relatively soluble aquatic herbicide used for the control of numerous unbmerged aquatic weed species. Water was obtained from Pat Mayse Lake, a meso-oligo-complex resource in northeast Texas, Sediments was obtained from Pat Mayse Lake, a meso-oligotrophic reservoir in northeast Texas. Sediments were obtained from Pat Mayse Lake and Roselawn Cemetery Pond, a small eutrophic pond in north central Texas. The Pat Mayse Lake sediment was predominantly sand with low percent organic carbon, while the Roselawn Cemetery Pond sediment was predominantly clay with more than one percent organic carbon. Sorption of endothall in both systems was relatively low and can be considered as a minor process in the fate assessment of endothall in aquatic systems. The relatively high concentration of endothall required for acute toxicity, a low sorption coefficient, and low environmental persistence combined to make endothall a mental persistence combined to make endothall a candidate for the control of nuisance aquatic vegetation. (Baker-IVI) W85-00133

COST-BENEFIT ANALYSIS OF WETLAND

DRAINAGE, Leeds Univ. (England). School of Economic Stud-

J. K. Bowers. Environment and Planning A, Vol. 15, No. 2, p 227-235, February, 1983. 14 Ref.

Descriptors: *England, *Drainage, *Cost-benefit analysis, *Wetlands, Conservation, Land use, Flood protection, Flood damage, Agriculture, Resources development

nd areas of England are under imminent The wettand areas of England are under immment threat of drainage for agricultural improvement. The immediate cause is the local drainage surveys produced under the Water Act 1973. Problems identified in these surveys are subjected to cost-benefit appraisal. Examination of a selection shows that these appraisals are technically defective and result in an overstatement of the benefits and in an that these appraisals are technically defective and result in an overstatement of the benefits and in an overinvestment in land drainage. The main defects are: first, a failure to assess amenity and conserva-tion losses; second, use of prices that contain a substantial element of income transfer which is not netted out; third, a failure to properly calculate the rate of land conversion - a crucial variable; fourth, the project appraisal period is arbitrarily chosen or the project appraisal period is arbitrarily chosen or treated as a variable; fifth, the use of theoretical rather than expected agricultural yields; sixth, the level of flood protection aimed at is too high for the stated objective; and, last, anticipated flood losses are not deducted. (Author's abstract) W85-00278

RIVERS: OUR VANISHING HERITAGE, National Audubon Society, Washington, DC. H. Babcock. Environmental Forum, Vol. 2, No. 10, p 38-41, February, 1984. 2 Fig.

Descriptors: *Rivers, *Water resources development, Conservation, Legislation, Regulations, Federal jurisdiction, Wilderness areas, Water use, Competing use, Wildlife habitats, Dams.

The basic problem with rivers is that everyone wants to use them in different and often mutually exclusive ways. More than 67% of all the water used in 1970 came from rivers. Currently, rivers in their wild state are losing the battle against the consumptive side of society. An increase has been noted lately in applications to dam free flowing rivers. One incentive for such dam building has been the Public Heilitz Benthere, Public Lie and Problems. rivers. One incentive for such dam building has been the Public Utility Regulatory Policies Act of 1978 which requires utilities to purchase power from small producers of electricity from renewable sources of energy, such as from falling water. While there are environmental benefits from hydroelectric development as these facilities offer clean, safe and cheap energy, there are obvious costs in that dams and diversion projects drown valuable riparian habitats, change the natural temperatures of the waters, increase sittation, concenperatures of the waters, increase sittation, concenvaluable riparian habitats, change the natural tem-peratures of the waters, increase siltation, concen-trate pollutants and affect the amount of oxygen in the water. As long as there is no national water policy, rivers will continue to be at the mercy of random and haphazard development. Presently the

only way to prevent federal diversion or impound-ment of outstanding rivers is to designate them under the Wild and Scenic Rivers Act of 1968. Lacking effective tools to protect rivers either legislatively or administratively, the conservation registatively or administratively, the conservation community will have to push for strengthening amendments to the Wild and Scenic Rivers Act or to a major overhaul of the Federal Energy Regulary Commission procedures to balance the scales more evenly between river conservation and river destruction. (Baker-IVI) W85-00282

AQUIFER MODELING WITH A HANDHELD CALCULATOR - AQMODL, Ministry of Planning, Riyadh (Saudi Arabia). F. A. Rayner. Ground Water, Vol. 21, No. 1, p 84-91, January-February, 1983. 2 Fig. 1 Tab, 8 Ref.

Descriptors: *Aquifer characteristics, *Model studies, *Computer models, Water level, Programmable calculators, Geohydrology.

Groundwater resource personnel are often faced with the need to quickly determine what effects a particular aquifer development scheme will have on a geohydrologic regime. AQMODL is an analytical mathematical aquifer modeling program for the HP-41C handheld programmable calculator. No written instructions are required for its use. The operator is guided through the steps and errors generated by the operator are avoided. Anyone only basically familiar with the operation of the HP-41C calculator and with aquifer modeling can use the instrument. No special key assignments exist and no special data preparation or storage operations or any other prior preparation is ments exist and no special data preparation or storage operations or any other prior preparation is necessary before running AQMODL, simply XEQ AQMODL and follow the guidance supplied by the calculator. AQMODL can be used to model simple or complex single aquifer situations. It con-siders any regional change in water level not nec-essarily associated with the development being modeled. It also models the aquifer's water level gradient. For a 60 active well model the total calculator execution time with the nrinter attached grautem. For a to active well model the total calculator execution time with the printer attached would be about 6.9 minutes to determine the change in water level and elevation at one observa-tion point. (Baker-IVI) W85-00362

FRENCH AND EUROPEAN NAVIGABLE WATERWAY SYSTEMS (LES RESEAUX DES VOIES NAVIGABLES FRANCAIS ET EUROPE-

Houille Blanche, No. 2/3, p 81-86, 1981. 2 Fig, 2

Descriptors: *Navigable waters, *Waterways, *France, *Europe, Regulations, Navigable rivers, Hydraulic engineering, Reviews.

The importance of past waterway engineering ac-complishments is highlighted in a brief review. The development of general river equipment and infrastructures is traced and present French classi-fication standards are given for navigable water-ways. The lengths and percentages in each major category of West European waterways are tabulatcompany or west European waterways are tabulated with corresponding traffic figures for 1978 and 1979. The more important developmental projects currently underway are described. (Baker-IVI) w85-00368

WATER SUPPLY METHODS FOR NAVIGA WATER SUPPLY METHODS FOR NAVIGABLE WATERWAYS; OPTIMIZATION OF A PROJECT WITH LOCKS; PUMP STATIONS (LES METHODES D'ALIMENTATION EN EAU DES VOIES NAVIGABLES; OPTIMISATION D'UN PROJET AVEC ECLUSES; LES STATIONS DE POMPAGE), Pommier, A. Terrier, Le Grand, and Olivier. Houille Blanche, No. 2/3, p 87-92, 1981. 4 Fig.

Descriptors: *Navigable waters, *Hydraulic cagineering, *Gates, *Locks, Navigation, Waterways, Saone-Rhine Canal, Canals, Gravity flow, Water supply, Pumps, Optimization, Systems analysis, Water reuse.

Major problems have always existed in the designing of water supply systems for waterway locks at sill crossings. Due to modern increases in the extent and height of the locks, the problems have magnified. A partial gravity supply system at the dividing reach is provided by the wide gauge Saone-Rhine canal link project. In addition, arrangements for economizing and recycling the water to make up for the deficiency in natural gravity supplies is also a part of this project. The efficiency and optimization of this overall system is analyzed and the advantages and limitations of each of its many components are demonstrated. (Baker-IVI)

HOW THE MAIN-DANUBE LINK FACILI-TATES NAVIGATION AND SAVES WATER (LA LIAISON MAIN-DANUBE FAVORISE LA NAVIGATION ET L'ECONOMIE DE L'EAU), B. Rumelin. Houille Blanche, No. 2/3, p 93-98, 1981. 2 Fig, 4

Tab. 4 Ref.

Descriptors: *Navigable waters, *Locks, *Main-Danube link, Waterways, Design criteria, Hydrau-lic engineering, Construction, Flood control, Water supply, Water resources development,

Locks will be provided for the Main-Danube link with a large differential level and lateral water saving basins designed to reduce their water needs. Water will have to be pumped from the Danube and Altmuhl to a reservoir near the dividing reach by pump stations connected with the locks in order to obtain a sufficient increase to the natural inforcer. All pumps stations on the southern incline the southern inclined to obtain a sufficient increase to the natural inflows. All pump stations on the southern incline will feature three pumps operating in conjunction with a barrage in addition to the lock operating pumps. This system will improve low water flow in the Main and Regnitz rivers with a view to interregional hydraulic regulation. Flood flows of the river Altmuhl will be retained in a damping basin, from which they will be routed to a further reservoir through a tunnel underneath the Danube-Rhine watershed, and finally into the Regnitz River. (Baker-IVI) W85-00370

HYDRAULIC CIRCUIT DESIGN AND ITS EF-FECTS ON THE CIVIL ENGINEERING FEA-TURES OF LOCKS (LA CONCEPTION DES CIRCUITS HYDRAULIQUES ET SES REPER-CUSSIONS SUR LE GENIE CIVIL DES

Houille Blanche, No. 2/3, p 99-102, 1981. 4 Fig.

Descriptors: *Navigable waters, *Locks, Hydraulic engineering, Design criteria, France, Circuits, Construction, Waterways.

The close dependence of a lock on the hydraulic function for which it is designed is reviewed. Hydraulic circuits of French wide gauge waterways are invariably designed for a locking time which will not exceed 5 minutes. At the same time assurance is given that acceptable conditions for boats in the lock and canal reach will be maintained. A mitable filling and emptying waters is chosen from suitable filling and emptying system is chosen from the four available alternatives which is dependent on the differential level across the lock. The choice on the differential level across the lock. The choice of system will in turn govern the general lock structure. A brief description is offered of the other lock design developments such as those concerning gates, general equipment and civil engineering features. (Baker-IVI) W85-00371

LOCKS ON THE WIDE-GAUGE RHONE WA-TERWAY (LES ECLUSES D'UNE GRAND GABARIT: LE RHONE),

Houille Blanche, No. 2/3, p 103-108, 1981. 8 Fig.

Descriptors: *Navigable waters, *Waterways, *Locks, *Rhone Waterway, Hydraulic engineering, Construction, Design criteria.

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

Between Lyons and the Mediterranean Sea lies the wide gauge Rhone waterway. The waterway features twelve locks which are designed to handle European standard pusher units. The fall across the locks determines the type of hydraulic circuit designed into them. Filling and emptying of the locks is done through the bottom or cross culverts. The effects of some of the aspects of the development of these supply systems on construction requireof these supply systems on construction require-ments are described. The flow cutoff and safety equipment used in the system is also delineated (Baker-IVI)

WIND AND WAVE REGIMES OF THE KIEV PUMPED-STORAGE STATION RESERVOIR, M. N. Rubanik, P. D. Gavrish, V. M. Kondrat'ev, and V. F. Kanarskii.

and V. F. Kanarski. Hydrotechnical Construction, Vol. 16, No. 4, p 199-203, April, 1982. 3 Fig. 2 Tab, 4 Ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 12-14, April, 1982.

Descriptors: *Pumped storage reservoirs, *Wind, *Waves, *Kiev Pumped Storage Reservoir, *USSR, Reservoirs, Slope stability, Slope, Dikes,

The reservoirs of a pumped-storage station (PSS) operate in a regime of daily regulation of the volumes and levels of the water, giving rise to certain characteristics of the effect of the wind and wave regime on the dike slopes. The size of the reservoir at the Kiev pumped storage station is 1450 x 450 m, the length of the dike is 4.7 km, depth at normal pool level is 8 m and at dead storage level is 2 m. The average wind speed in the summer is 3.6 m/sec. The most wave-hazardous directions of the winds are east and west. The probability of a calculated wind speed in wave-hazardous directions is supposed to be taken on the basis of a relation obtained by analyzing by a numerical method the data of on-site observations of the operating regime and conditions of operating the Kiev PSS. In the case of operating the PSS in two cycles the conditions of the wind and wave regime are alleviated, and the probability of occurin two cycles the conditions of the wind and wave regime are alleviated, and the probability of occur-rence of a wave-hazardous situation decreases. In the case of a well adjusted system of regulating the water levels in the reservoir it is expedient to considerably reduce the freeboard, confining one-self just to the value of the design freeboard and installation of an effective limiter of the uprush of waves on the slope. In this case the height of the dike and its cost are reduced. A still greater reduc-tion of the effect of strong winds on the wave tion of the effect of strong winds on the wave regime of the reservoir can be attained by creating in wave hazardous directions, and, better still, around the entire reservoir, forest belts analogous to the windbreaks on farmlands and along high-ways. (Baker-IVI)

METHOD OF DETERMINING THE MAXIMUM FLOOD INFLOW TO THE MIDDLE ENISEI HYDROELECTRIC STATION, A. E. Asarin, B. S. Tseitlin, L. Ya. Dzheibo, and M. N. L'vova.

M. N. L. Vova. Hydrotechnical Construction, Vol. 16, No. 8, p 427-431, August, 1982. 6 Tab. Translated from Gidrotekhnichkeskoe Stroitel'stvo, No. 8, p 21-23,

Descriptors: *Flood control, *Prediction, *Middle Enisei Hydroelectric Station, Runoff, Hydroelec-tric plants, Reservoirs, Flow.

A method of determining the maximum inflow to the cascade of hydrostations is described with an illustration of the quantitative calculation results for particular reservoirs. The runoff of the Angara is regulated by reservoirs of the Irkutsk, Bratskm, and Ust'llim hydroelectric stations, and a fourth reach of the Angara cascade, the Boguchany hyreach of the Angara cascade, the Boguchany ny-droelectric station is currently under construction. The volume of stream-gauging data on the runoff of the Angara with its relatively little variability makes it possible to rather reliably establish the statistical parameters of the maximum discharges and discharges of various probabilities at reference sites. The calculated inflow to the cascade-ar-

ranged hydrostations is determined as the sum of the discharges being released into the lower pool of the upstream hydrostation and local inflow from the drainage basin between the upstream hydrostation and downstream hydrostation under consideration. The method of constructing the design hydrograph of inflow to the upstream hydrostation or to the first hydrostation under construction is rather simple. In order to establish the admissibility of the method, the stochastic relation between the maximum flood discharge (freshet) and its volume was determined. (Baker-IVI)

EXPERIENCE IN THE OPERATION OF OVERFLOW BUTTRESS DAMS UNDER SEVERE CLIMATIC CONDITIONS, D. M. Yashkul', and V. V. Belov. Hydrotechnical Construction, Vol. 16, No. 8, p 474-478, August, 1982. 3 Fig. 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 53-56, August, 1982.

Descriptors: *Buttress dams, *Dam construction, *Reservoir operation, *Climate, Overflow, Concrete, Frost resistance, Spillways, Design criteria.

A buttress design of overflow dams makes it possible to substantially reduce the volume of concrete works compared to massive dams. Thin-walled structures require the use of high concrete grade with respect to strength and frost resistance, increased reinforcement, more careful placement of the concrete mix, and high quality of sealing the expansion and horizontal joints, particularly at the points of their intersection. The downstream surface of the dams protects the upstream faces from freezing completely through without additional construction or operating measures. The exposed rock foundation on the hollows between the buttresses not only reduces uplift but also provides free outflow of seepage water and the possibility of more complete checking of the connection of the concrete structures with the foundation. The operating expenses of overflow buttress dams are pracconcrete structures with the foundation. The operating expenses of overflow buttress dams are practically the same as on dams without internal hollows and their maintenance amounts mainly to periodic painting of the inside metal structures, repair of individual sections of the concrete on the spillway surface, warming of the inlet and drainage outlets, and regular inspection. (Baker-IVI) W85-00486

CONSTRUCTION OF THE FLOOD (FRESHET) HYDROGRAPH OF A GIVEN PROBABILITY WITH CONSIDERATION OF ITS UNFAVOR-ABLE SHAPE,
For primary bibliographic entry see Field 2E.
W85-00489

USE OF SIMPLIFIED ON-SITE CHARACTER-ISTICS WHEN AUTOMATING WATER AC-COUNTING AT HYDRAULIC STRUCTURES, I. S. Sarzhinskii, and Yu. K. Zhuskov. Hydrotechnical Construction, Vol. 17, No. 9, p 471-479, September, 1983. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 52-54,

entember, 1983.

Descriptors: *Water management, *Computers, *Automation, Water quantity, Water distribution, Hydraulic structures, Irrigation water, Mathematical equations.

Water accounting and distribution can be carried out quite accurately by means of calibrated orifices of the hydraulic structures. The use of on-site calibration characteristics with the use of a computer permits efficient regulation of discharges at hydraulic structures-regulators. The following system for controlling the operation of a water management system with the use of a computer is described. In the center of a cluster of hydraulic structures or irrigation systems a control center with a computer is created, which receives information from all hydraulic structures and gauging stations: openings of gates, head, storage, etc. On the basis of these data the computer calculates the values of the discharge for each structure, volume of flow, and balance over the entire watercourse.

The computer controls also the fulfillment of the water use plan. Input of the characteristics of the hydraulic structures and planned assignments is accomplished in the form of polynomials obtained as a result of mathematical processing of the initial data. (Baker-IVI)

EXPERIENCE IN OPERATING THE STRUCTURES OF THE MANSOUR EDDAHBI HY-DROPOWER DEVELOPMENT,

I. F. Blinov, and O. V. Sitnin. Hydrotechnical Construction, Vol. 17, No. 10, p 512-518, October, 1983. 4 Fig. 3 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 25-30, October, 1983.

Descriptors: *Arch dams, *Monitoring, *Mansour Eddahbi, *Morocco, *Reservoir operation, Water resources development, Irrigation, Hydroelectric

The ten year experience of operating the structures and equipment of the hydrostation at the Mansour Eddahbi development has shown that the reservoir created by the arch dam provides streamflow regulation for meeting the irrigation needs of 25,000 ha in the Dras River valley and the hydrostation provides the design production of electric energy. The inspection data for the hydrostation indicates The inspection data for the hydrostation indicates a satisfactory condition of the structures and equipment. The monitoring equipment installed in the dam permits operative monitoring of the safe operation of the dam. About 90% of the installed equipment is operating satisfactorily after 10 years. An analysis of long term observation data shows that at the design head the stresses, strains, displacements, and seepage stability of the dam foundation and bank abutments correspond to the design assumptions. (Baker-IVI) W85-00502

HYDROPOWER UTILIZATION SCHEME OF THE EUPHRATES RIVER IN SYRIA.

V. A. Kozlov.

Hydrotechnical Construction, Vol. 17, No. 10, p 522-526, October, 1983. 1 Fig, 1 Tab, 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 32-36, October, 1983.

Descriptors: *Water resources development, *Planning, *Hydroelectric plants, *Euphrates River, *Syria, Evaluation, Decision making, Dam construction, Irrigation. *Water resources development,

Runoff of the Euphrates River is formed mainly from snowmelt in the high mountain part of the basin and by rains falling in the period from November to May. The drainage area at the stream gauging station at Keban, located 10 km below the confluence of the Karasu and Murat, is about 65,000 sq km and at the Turkey-Syria border reaching 110,000 sq km. The natural annual runoff of the river in the region of Tabqa during the 40 year period of observation varied from 10.4 to 41.5 cu km with a mean annual volume of 26.2 cu km. year period of observation variet from 10.5 to 41.5 to ation of two reservoirs one by a dam constructed at Tabqa with a NPL at 300 m and the second reservoir created by a dam constructed at Yusef Pasha with a NPL at 320-325 m. The higher tech-Pasha with a NPL at 320-325 m. The higher technicoeconomic indices of the two step variant over the variant of using the river in one step was determined. In 1964 plans for a gravity irrigation of 100,000 ha by constructing a low head dam with a small hydroelectric station in the region of Halebiyah-Zalyabiyah and scheme of irrigation in the basin of the al-Khabur River were drawn up. In 1968 a project plan for irrigating 185,000 ha of the Balikhy area was proposed. At present there are two variants of expanding the power utilization of the Euphrates in the stretch from the boundary with Turkey to the site of the Euphrates project: with Turkey to the site of the Euphrates project: increase of the normal pool level of the reservoir of the Euphrates project by 20 m to 320 m; or

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construction of the Tishrin hydrostation near Yusef Pasha. (Baker-IVI) W85-00504

4B. Groundwater Management

PROBLEMS OF RISING GROUND-WATER LEVELS IN URBAN AREAS WITH SPECIAL REFERENCE TO THE LOUISVILLE, KENTUCKY AREA,

Geological Survey, Louisville, KY. Water Resources Div.

D. V. Whitesides, R. J. Faust, and D. D.

Available from the OFSS, USGS, Box 25425, Fed. Ctr., Lakewood, CO 80225, USGS Water-Resources Investigations Report 83-4233, 1983. 26 p, 12 Fig, 1 Tab, 35 Ref.

Descriptors: *Potentiometric level, *Water table, Stream-groundwater relations, *Natural recharge, Hydrographs, Precipitation, *Kentucky, Louisville, Jefferson County, *Groundwater levels.

Rising ground-water levels are a problem for cities such as San Bernadino, California; Greely and Fort Collins, Colorado; New York City boroughs of Brooklyn and Queens; and Louisville, Kentucky. Ground-water levels showed a steeply rising trend in the alluvial aquifer underlying Louisville during the early and middle 1970's in response to above average precipitation and a decrease in ground-water withdrawals. This rising trend flattened in 1979 and the water levels are stabilizing at 25 to 45 feet below land surface in the downtown area. Basements are generally 20 to 25 feet below land surface in this area. Because of the shallow depth to water, any resumption of the upward tread would require preventive measures such as selective dewatering to avoid damage to some structures. (USGS)

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE IRONTON-GALESVILLE AQUIFER, SOUTHEAST MIN-NESOTA.

Geological Survey, St. Paul, MN. Water Resources Div.

J. F. Ruhl, R. J. Wolf, and D. G. Adolphson. USGS Water-Resources Investigations Report 82-4080, (1982). 2 Maps, 15 Fig. 2 Tab, 20 Ref.

Descriptors: *Aquifer characteristics, *Water quality, *Underground waste disposal, Hollandale embayment, Ironton-Galesville aquifer, *Minnesota, *Groundwater.

The (Franconia)-Ironton-Galesville aquifer is part of a sequence of sedimentary bedrock units in southeast Minnesota. The aquifer was deposited from Paleozoic seas that occupied a shallow depression known as the Hollandale embayment. The surface of the Ironton-Galesville aquifer discoward the interior of the embayment. The aquifer is as deep as 1,000 feet below land surface and as thick as 325 feet. The Ironton and Galesville Sandstones are white and medium grained. They are the most productive units of the aquifer throughout the area. The Franconia Formation is a coarse grained sandstone and interbedded shale. The Franconia Formation is water bearing primarily in the northern and western parts of the area; where it is the uppermost bedrock aquifer, elsewhere it yields little water. Its water quality is generally acceptable for all types of use. Calcium magnesium bicarbonate type water is most common. Confining beds protect the aquifer from surface pollutants, but the water is degraded locally in some places. Dissolved solids are as high as 1,000 mg/L in the southwest because of highly mineralized recharge water from Cretaceous deposits. (USGS)

SUBSURFACE STORAGE OF FRESHWATER IN SOUTH FLORIDA: A PROSPECTUS,

Geological Survey, Tallahassee, FL. Water Resources Div. M. L. Merritt, F. W. Myer, W. H. Sonntag, and D.

J. Fitzpatrick. Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4214, 1983. 69 p, 6 Fig. 8 Tab, 75 Ref.

Descriptors: *Injection wells, *Underground storage, *Feasibility studies, Water supply, *Florida, *Cyclic injection, Freshwater injection.

A method of increasing storage capacity for freshwater in south Florida is to use brackish artesian aquifers as reservoirs. In this way, water deficiencies occurring during the annual dry season can be offset by surplus water obtained during the wet season and injected underground. Most of south Florida is underlain by several deep, confined, carbonate waterbearing zones which might be suitable for freshwater storage. These zones are in the Avon Park, Ocala, Suwannee, Tampa, and Hawthorn Formations. Experimental freshwater injection systems have been operated at five locations with promising, but not fully definitive, results. A determination of the feasibility of freshwater injection at a selected site begins with an assessment of the local geologic suitability. Verification of feasibility, however, requires injection and recovery tests to be performed at the site. Recovery efficiency, a measure of the success of the operation, is the amount of potable water, expressed as a percentage of the volume injected, which can be recovered before its salinity, or the concentration of other chemical constituents present in the native aquifer water, increases to the point that the recovered water is no longer useable. (USGS) W85-00029

WATER RESOURCES OF THE TULALIP INDIAN RESERVATION, WASHINGTON, Geological Survey, Tacoma, WA. Water Re-

sources Div. B. W. Drost.

B. W. Drost. Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Open-File Report 82-648, 1983. 153 p, 22 Fig. 17 Tab, 21 Ref.

Descriptors: *Hydrologic budget, *Groundwater recharge, *Aquifer characteristics, *Saline water encroachment, Low flow, *Tulalip Indian Reservation. *Washington.

An evaluation was made of the water resources of the Tulalip Indian Reservation to aid in decisions regarding future development of the area. Groundwater resources are sufficient to supply several times the 1978 population. Potential problems of salt-water encroachment in coastal areas and septic-tank contamination in shallow wells were identified. The general quality of surface water is adequate to allow for significant expansion of the Tribe's fisheries activities. Ground water is generally suitable for domestic use without treatment, that a serious quality problem is the presence of coliform bacteria in some shallow wells. High values of turbidity and color and large concentrations of iron and manganese are common problems regarding the esthetic quality of the water. In a few places, large concentrations of chloride and dissolved solids indicate the possibity of saltwater encroachment, but no ongoing trend has been identified. Surface waters have been observed to contain undesirably high concentrations of total phosphorus and total and fecal-coliform bacteria, and to have temperatures too high for fish-rearing. The concentration of nutrients appears to be related to flow conditions. Nitrate and total nitrogen are greater in wet-season runoff than during low-flow periods, and total phosphorus and ammonia concentrations are greatest in dry-season storm runoff. Generally, surface-water quality is adequate for fish-rearing and (with treatment) for public supply. (USGS)

HYDROLOGIC CONDITIONS IN THE WHEATLAND FLATS AREA, PLATTE COUNTY, WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
M. A. Crist.

Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Water-Resources Investigations Report 83-4047, 1983. 36 p, 11 Fig, 7 Tab. 24 Ref.

Descriptors: *Computer models, Simulation, *Irrigation, Water levels, *Aquifer, *Base flow, Surface-groundwater relationship, Pumpage, *Recharge, Hydrographs, *Wyoming, Platte County.

The area includes about 260 square miles in central Platte County that consists of Wheatland Flats and a border region. Wheatland Flats is an area of about 100 square miles that is bounded by Chugwater Creek on the east, the Laramie River on the north, and Sybille Creek on the west. The southern boundary is approximately the southernmost limit of alluvial terrace deposits. Surface water diverted from the Laramie River along with ground water from wells is used to irrigate about 57,000 acres most of which are on and adjacent to Wheatland Flats. More than 200 wells are used for irrigation, industrial, and municipal supplies. The wells are completed in an upper aquifer consisting primarily of shallow alluvial deposits of Quaternary age and a lower aquifer, the Arikaree Formation of early Miocene age. Net water-level decline after approximately 20 years (1958-60 to 1979) generally is test than 10 feet in each aquifer, although declines of as much as 13 feet have occurred in the Airkaree Formation at specific locations. A digital model was used to simulate hydrologic conditions in the Wheatland Flats area. The model indicated that ground-water discharge to streams decreased by 10 percent from 1971 to 1978. Stream-discharge measurements are not available to verify the loss. However, it is reasonable to assume, on the basis of hydraulic-head edeline in the aquifers, that there has been some ground-water contribution to the stream. (USGS)

HYDRAULIC CONDUCTIVITY, SPECIFIC YIELD, AND PUMPAGE -- HIGH PLAINS AQUIFER SYSTEM, NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.

For primary bibliographic entry see Field 7C. W85-00032

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART IV, HYDRAULIC CHARACTER-ISTICS OF THE WILCOX-CARRIZO AQUI-FER,

Geological Survey, Baton Rouge, LA. Water Resources Div.

G. N. Rvals.

Available from the OFSS, USGS, Box 25425, Federal Ctr., Denver, CO 80225. USGS Water Resources Investigations Report 83-4132, 1983. 9 p, 3 Fig. 1 Tab, 27 Ref.

Descriptors: *Hydraulic conductivity, Permeability, *Aquifer characteristics, Storage coefficient, Northern Louisiana salt-dome basin, *Louisiana, Vacherie salt dome, Wilcox-Carrizo aquifer.

The Wilcox Group of Paleocene-Eocence age and the Carrizo Sand of Eocene age compose the Wilcox-Carrizo aquifer. Results of 25 aquifer tests and permeability determinations from 43 sidewall cores show that the hydraulic characteristics of the aquifer are variable. Studies of the Carrizo showed that hydraulic conductivity increased as sand-bed thickness increased. Hydraulic conductivity averaged 29 feet per day for sand beds 25 to 100 feet in thickness and 40 feet per day for sand beds 100 to 200 feet in thickness. Based on the aquifer tests and sidewall core analyses, hydraulic conductivity does not increase with increased thickness for the Wilcox part of the aquifer. Permeabilities determined from sidewall core ranged from less than 1 to more than 3,000 millidarcies (less than 0.002 to more than 7.3 feet per day). Values of hydraulic

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Groundwater Management—Group 4B

conductivity determined from aquifer tests ranged from less than 1 to 35 feet per day. (USGS) W85-00034

ASSESSMENT OF TIME SERIES AS A METH-ODOLOGY TO QUANTIFY IRRIGATION RETURN FLOWS, Montana State Univ., Bozeman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W85-00071

HYDROLOGY OF THE NEWBERRY VOLCA-NO CALDERA, OREGON, Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 2F. W85-00084

PUMPING TESTS IN PATCHY AQUIFERS, Institute of Geological Sciences, London (England), Hydrogeology Unit. J. A. Barker, and R. Herbert. Ground Water, Vol. 20, No. 2, p 150-155, March-April, 1982. 4 Fig, 6 Ref, 1 Append.

Descriptors: *Patchy aquifers, *Pumping tests, *India, Mathematical equations, Simulation, Drawdown, Aquifers, Groundwater storage, Transmissi-

A numerical simulation and analytical study of a constant-rate pumping test, for a well situated at the center of a disc of anomalous transmissivity and storage coefficient, have been used to aid in the interpretation of tests performed in a 'patchy' aquifer in India. Equations describing the long-time behavior of drawdown show that Jacob's time behavior of drawdown show that Jacob's method can be employed to estimate the regional transmissivity from drawdowns measured at any point in the aquifer or in the pumping well. However, the equations also show that an average storage coefficient should be calculated from drawdowns measured outside the aquifer discontinuity. The results of this study support the hypothesis that the average transmissivity of a heterogeneous aquifer can be calculated from rates of drawdown observed after long periods of pumping. (Author's abstract) (Author's abstract) W85-00300

PROGRAMMABLE HAND CALCULATOR PROGRAMS FOR PUMPING TEST ANALYSES BY LEAST SQUARES' METHOD USING JACOB'S MODIFICATION OF THEIS' EQUA-TION,

TION, King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences. S. A. S. Sayed. Ground Water, Vol. 20, No. 2, p 156-161, March-April, 1982. 1 Tab, 13 Ref, 3 Append.

Descriptors: *Pumping tests, *Mathematical analysis, *Calculators, Drawdown, Transmissivity, Stor-

Pumping test analysis methods commonly used are graphical, although statistical approaches and the direct computation of transmissivity and storativity by the least squares' method have been made in recent years. Two programs are given for the CASIO FX-502 programmable calculator for direct computation of transmissivity and storativity from time-drawdown and distance-drawdown data. These aquifer parameters are calculated from Jacob's modification of the Theis equation by the least squares' method. The programs also calculate drawdowns at various times and distances using the computed transmissivity and storativity. A number of pumping tests were analyzed by these number of pumping tests were analyzed by these programs and the results were quite close to those obtained by graphical methods. (Moore-IVI) W85-00301

HYDRAULIC CONDUCTIVITY OF A GLACIAL TILL IN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Irrigation Div. M. J. Hendry.

Ground Water, Vol. 20, No. 2, p 162-169, March-April, 1982. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Glacial tills, *Alberta, *Permeability coefficient, Irrigation effects, Geohydrology, Drainage, Tritium, Geologic fractures.

Soils underlain at shallow depths (less than 1 m, 3 ft) by glacial till are generally considered undesirable for irrigation because of their unfavorable internal drainage characteristics. In some areas of southern Alberta, Canada, soils developed upon shallow tills have been irrigated successfully for over 60 years with no adverse effects on the soil. An investigation was conducted to describe the hydrogeological properties of till under one of these areas and to assess the properties with regard to drainage. Study techniques consisted of detailed test drilling and sampling, excavation of test pits, installation and monitoring of ground-water instrumentation, field and laboratory hydraulic conductivity testing and tritium analyses of ground-water samples. Two fracture sets were found in this till. Both sets of fractures produce secondary permea-Soils underlain at shallow depths (less than 1 m, 3 tivity testing and tritium analyses of ground-water samples. Two fractures produce secondary permeabilities which mask the low hydraulic conductivity of the till matrix (10 to the -10 m/s). Small-scale fractures which have a fracture spacing of approximately 10 mm (0.4 in.) have an apparent mean hydraulic conductivity of 5 x 10 to the -9 m/s, whereas large-scale fractures which have fractures spacings from 20 mm (0.8 in.) to over 630 mm (2 ft) have an apparent mean hydraulic conductivity of approximately 2 x 10 to the -7 m/s. The high hydraulic conductivity of the large-scale fractures was corroborated by tritium analyses of groundwater samples. Tritum analyses also indicate the presence of recent water at depth in the till. The large-scale fractures, which control the bulk hydraulic conductivity of this till, provide conduits through which infiltrating water can be transmitted to the ground-water regime. These fractures are believed to be the reason why this land has remained irrigable for over 60 years. (Author's abstract) W85_00302

LOWER HAWTHORN AQUIFER ON SANIBEL

Law Engineering Testing Co., Marietta, GA. L. H. Motz.

Ground Water, Vol. 20, No. 2, p 170-178, March-April, 1982. 11 Fig, 2 Tab, 15 Ref.

criptors: *Sanibel Island, *Florida, *Hawthorn aquifer, "Groundwater potential, Brackish water, Water supply development, Dissolved solids, Transmissivity, Groundwater storage, Pumping tests, Geohydrology, Saline water intrusion.

In 1977, the Island Water Association (IWA) on In 1977, the Island Water Association (IWA) on Sanibel Island, Florida, was concerned that the total dissolved solids concentrations in several wells in its well field were increasing and might cause the blended raw water to exceed the design capacity of its electrodialysis plant. Test wells were drilled several miles west of the existing well. capacity of its electrodialysis plant. Test wells were drilled several miles west of the existing well field, and two pumping tests, one at the site of the test wells and the other in the existing well field were run. Average values for the transmissivity (T), storage coefficient (S), and leakance (K'/b') of the lower Hawthorn aquifer were determined to be T = 1,290 sq ft/d (119 sq m/d), S = 0.000027, and K'/b' = 0.00000747 (I/d). The results of the pumping tests and other findings indicated that pumpage from the lower Hawthorn aquifer was being derived from artesian storage in the aquifer and from vertical leakage into the aquifer from adjacent formations. It was estimated that the IWA would be able to recover usable water from the lower Hawthorn aquifer for about 5 more years by drilling new wells in the vicinity of the test wells and in other nearby areas that might be determined to yield usable water. After this period of time, it likely would become increasingly difficult, if not impossible, to obtain large quantities of usable water from the lower Hawthorn aquifer, unless significant quantities of water could be found in areas in which few data were then available. The principal recommendations, which subsequently were acted upon by the IWA, were to conduct drilling and testing in the lower Hawthorn aquifer several miles west of the test wells and to investi-

gate the underlying Suwannee aquifer and deeper zones as possible sources of large quantities of brackish water. (Author's abstract)

RISING GROUND WATER - PROBLEM OR RESOURCE Louisville Univ., KY. Dept. of Civil Engineering.

D. J. Hagerty, and K. Lippert. Ground Water, Vol. 20, No. 2, p 217-223, March-April, 1982. 7 Fig. 1 Tab, 14 Ref.

Descriptors: *Groundwater, *Water table, *Louis-ville, *Kentucky, Urban areas, Pumping rates, Pre-

An accelerated rise of the groundwater table in in An accelerated rise of the groundwater table in in Louisville, Kentucky has caused concern to municipal officials and building owners in the central urban area. An average rise of more than 1 m (35 feet) occurred between 1969 and 1980. In central Louisville, rising ground water could create: slight but significant possibilities of structural settlement problems; high possibilities of damage to basement floors and walls; and very high possibilities for disruption of utility conduits. Historical data indicated that ground-water levels in a system undiscated that ground-water levels in a system undiscated cated that ground-water levels in a system undis-turbed by man could reach ground surface eleva-tions in central Louisville. There is a strong relations in central Louisville. There is a strong relation between average ground-water levels and changes in pumping rates and incident precipitation. An extremely high correlation (R = 0.995) was found between average ground-water levels in 1966-1980 and cumulative departures in precipitation and pumping rates from 1950-1965 average precipitation and pumping rates. (Moore-IVI) W85-00307

CYCLIC STORAGE: A PRELIMINARY AS-SESSMENT,

Washington Univ., Seattle. Dept. of Civil Engi-

D. P. Lettenmaier, and S. J. Burges. Ground Water, Vol. 20, No. 3, p 278-288, May-June, 1982. 6 Fig. 2 Tab, 17 Ref.

Descriptors: *Cyclic storage, *Groundwater storage, *Conjunctive use, Storage reservoirs, Flow buffering, Aquifer management, Artificial recharge, Model studies, Simulation, Cost analysis.

Cyclic groundwater storage represents an alterna-tive which can reduce or eliminate the necessity for surface storage. Such a system may be operated for surface storage. Such a system may be operated in conjunction with a surface reservoir. The performance of a simplified water resource system consisting of a single surface reservoir and adjacent aquifer storage operated as a coupled flow buffering device is investigated on an annual scale to provide insight into the most important physical and climatic (streamflow) parameters governing cyclic storage performance. The hypothetical system is fully characterized by aquifer capacity, pumping and recharge capacity, surface storage pumping and recharge capacity, surface storage size, annual demand, and reservoir inflow statistics, size, annual demand, and reservoir inflow statistics, including annual mean, coefficient of variation, skew coefficient, lag one correlation coefficient, and Hurst coefficient. System performance under a range of these parameters is reviewed via Monte Carlo simulation; for the cases considered system performance is almost always limited by total system storage (sum of surface and aquifer storage). The cost of providing flow buffering via development of subsurface storage is about an order of magnitude less than for surface storage in the cases considered. (Moore-IVI)

SULFATE-REDUCING BACTERIA GROUND WATER FROM CLOGGING AND NONCLOGGING SHALLOW WELLS IN THE NETHERLANDS RIVER REGION,

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands). C. G. E. M. van Beek, and D. van der Kooij.

Ground Water, Vol. 20, No. 3, p 298-302, May-June, 1982. 3 Fig, 3 Tab, 16 Ref.

Field 4-WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B-Groundwater Management

Descriptors: *Netherlands, *Clogging, *Wells, *Sulfate reducing bacteria, *Groundwater, Bacteria, Anaerobic conditions, Iron sulfide.

In the Netherlands, the majority of well fields in the river region, where anaerobic water is with-drawn from the shallow aquifer, have problems with well clogging. When this type of clogging occurs, usually all wells in a given field are in-volved. This indicates that the cause of clogging is volved. This indicates that the cause of clogging is connected with the geohydrochemical or geomicrobiological characteristics of the aquifer. It has been suggested that well clogging may be due to iron sulfide formation induced by sulfate reducing bacteria. In order to test the supposition that sulfate-reducing bacteria play a role in this clogging process, sulfate-reducing bacteria in water from wells in well fields with and without the occurrence of clogging ware enumerated hymphers of wells in well fields with and without the occur-rence of clogging were enumerated. Numbers of sulfate-reducing bacteria were estimated by using the MPN technique. The sulfate-reducing bacteria count varied from less than 2/100 ml to 920/100 ml. In water withdrawn from nonclogging wells, the MPN of sulfate-reducing bacteria averaged 5 per 100 ml, whereas in wells subject to clogging, the number averaged 25 per 100 ml. A statistical analysis by Wilcoxon's order test confirmed that a significant difference, exists between the numbers analyses by Wilcoxon's offer less commerce that a significant difference exists between the numbers of sulfate-reducing bacteria in clogging and non-clogging wells. No causal relation has been proven to exist between this type of well clogging and the presence of sulfate-reducing bacteria. (Moore-IVI) W85-00313

REPRESENTATION OF MULTIAQUIFER WELL EFFECTS IN THREE-DIMENSIONAL GROUND-WATER FLOW SIMULATION, Geological Survey, Reston, VA.
G. D. Bennett, A. L. Kontis, and S. P. Larson. Ground Water, Vol. 20, No. 3, p 334-341, May-June, 1982. 6 Fig, 11 Ref.

Descriptors: *Groundwater movement, *Simulation, *Well effects, *Multiaquifer wells, Multilayer wells, Mathematical models, Aquifers, Geohydro-

A problem exists with respect to the simulation of multiaquifer or multilayer wells (wells which penetrate and are open to several different aquifers or layers). Such wells, whether or not they are pumped, can have a major effect on the hydraulics of the system. The presence of multiaquifer or multilayer wells changes the nature of the equations which must be solved in a three-dimensional ground-water flow simulation and, in effect, alters the stencil of computation. A method has been devised which takes this changes into consideration by allowing simulation of the hydraulic effects of a multiaquifer well on the aquifer system. It also allows for calculation of the water level and individual aquifer discharges in such a well. The It also allows for calculation of the water level and individual aquifer discharges in such a well. The method is satisfactory for the case of a single well located exactly at a node, in a model utilizing a square-mesh spacing, where radial symmetry is not disturbed by anisotropy, heterogeneity, or hydrologic boundaries. Application of the method to other situations is more difficult to rationalize, and depends in part upon whether a meaningful estimate of r sub a can be obtained for those situations. (Moore-IVI)

EVALUATING AND IMPROVING EXISTING GROUND-WATER SYSTEMS, California Univ., Davis. Dept. of Civil Engineer-

ing.
O. J. Helweg.
Ground Water, Vol. 20, No. 4, p 402-409, July-August, 1982. 6 Fig. 7 Tab, 10 Ref.

Descriptors: *Pump efficiency, *Well efficiency, *Groundwater, Energy, Drawdown, Specific capacity, Pumping tests.

Considerable energy savings are available from improving well and pump efficiencies. One major problem is evaluating the well and pump inefficiencies over prolonged periods of time, because these efficiencies are erratic unless normalized. A new well should be tested at different discharges to

construct a relationship between specific capacity and drawdown. Future well efficiency tests should compare the specific capacity with the original curve at the test discharge. The departure from the original curve indicates the loss in well efficiency. Similarly, pump efficiency needs to be normalized, so that the tested efficiency may be compared with the original efficiency at the test discharge. (Author's abstract) W85-00319

ADVECTION-DISPERSION INTERPRETA-TION OF TRACER OBSERVATIONS IN AN AOUIFER

Stanford Univ., CA. Dept. of Applied Earth Sci-

ences. E. Hoehn, and P. V. Roberts. Ground Water, Vol. 20, No. 4, p 457-465, July-August, 1982. 4 Fig. 3 Tab, 25 Ref. Swiss NSF grant 82.816.0.80, EPA grant R-804431, OWRT grant 14-35-0001-8824.

Descriptors: *Advection, *Dispersion, *Tracers, *Artificial recharge, *California, Mathematical models, Simulation, Injection wells, Wastewater renovation, Aquifers, Tailing, Reclaimed water.

An advanced wastewater treatment facility and a well field operated for artificial recharge in the Palo Alto Baylands (California) have been previ-ously used to evaluate whether direct injection of municipal effluents is a reliable and feasible strate-gy for producing reclaimed water. To complement this work, field experiments using conservative tracers have been carried out at the same site to evaluate the adequacy of an advection-dispersion. evaluate the adequacy of an advection-dispersion model. A stimulus-response approach based on chemical reactor theory was applied. Two different pulse stimuli at an injection well resulted in responses in two observation wells located at distances of 8 and 17 m, respectively from the injection well. The wells are perforated over the entire aquifer thickness of 1-2 m. The behavior of the two aquifer thickness of 1-2 m. The behavior of the two conservative tracers agreed closely with each other. Breakthrough response curves revealed extended trailing edges (tailing), especially at the nearer well. A two-domain model is employed to extend the simple advection-dispersion equation to account for the observed tailing. Response curves of concentrations were fitted with finite-difference simulations using the two-domain model. The simulations using the two-domain model agreed well ulations using the two-domain model agreed well with the field observations. The responses at the more distant well were characterized by values of dispersivity equal to or slightly smaller than those as the nearer well. The amount of field data required to simulate the observations was justified in the light of the overall purpose of gaining insight into the transport behavior of water and solutes during recharge operations. (Moore-IVI) W85-00326

UNRELIABILITY OF OPEN OBSERVATION BOREHOLES IN UNCONFINED AQUIFER PUMPING TESTS, Birmingham Univ. (England). Dept. of Civil Engi-

neering. K. R. Rushton, and K. W. F. Howard. Ground Water, Vol. 20, No. 5, p 546-550, Septem-ber-October, 1982. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Water table aquifers, *Pumping tests, *Observation wells, Aquifers, Boreholes, Mathematical models, Groundwater movement, Piezo-

The estimation of the transmissivity and storage coefficients in unconfined aquifers from pumping tests often proves to be difficult. For tests, an additional 200 mm diameter borehole was constructed at 34.5 m from the main pumping well. Pumping tests were carried out initially using the new borehole as an observation well. The regional aquifer response over a long time period indicated a specific yield of 10% to 15% but pumping tests did not appear to support these estimates. When separate piezometers were installed along a vertical section, there were significant differences in groundwater head. These differences suggest that rather than providing an average groundwater head, the open borehole provides a means of flow estimation of the transmissivity and storage

between the different elevations and therefore produces misleading results. Readings from open observation wells should be used with caution. When a number of piezometers are provided on a vertical section, a detailed picture can be obtained of the vertical components of flow. Using a numerical model for pumping test analysis it is possible to reproduce the observed aquifer behavior both at the free surface and at depth within the aquifer. (Moore-IVI) W85-00331

HAND CALCULATOR PROGRAM FOR EVAL-UATING THEIS PARAMETERS FROM A PUMPING TEST,

Electronic Associates, Inc., West Long Branch,

J. Paschetto, and C. D. McElwee. Ground Water, Vol. 20, No. 5, p 551-555, September-October, 1982. 2 Tab, 9 Ref.

Descriptors: *Pumping test, *Computer programs, Transmissivity, Storativity, Drawdown, Theis equation.

Automated techniques for analyzing pumping test data published recently usually require the services of a computer. With the advent of more sophisticated hand-held calculators, it is possible to implement these techniques on calculators. The program TFIT, originally written in FORTRAN, was adapted for use on the HP-41C hand-held calculator. With two memory, modules, up to 44 days. adapted for use on the HP-41C hand-held calcula-tor. With two memory modules, up to 44 draw-down-time pairs can be handled simultaneously. Given experimental pump test data, the program will yield approximations for aquifer transmissivity and storage coefficient, together with the rms error for drawdown. The complete Theis equation is used so there is no time or distance limitation. (Moore-IVI)

ECONOMICS OF IMPROVING WELL AND PUMP EFFICIENCY

California Univ., Davis. Dept. of Civil Engineer-

Ground Water, Vol. 20, No. 5, p 556-562, September-October, 1982, 6 Fig. 4 Tab, 6 Ref.

Descriptors: *Well efficiency, *Pump efficiency, *Economic efficiency, Energy costs, Pump testing, Cost analysis, Drilling, Design criteria.

Significant savings are frequently achieved from increasing well and pump efficiency by repair or replacement. The energy savings from rehabilitating wells and pumps may be modest for systems that are only slightly inefficient; the costs of the that are only slightly inefficient; the costs of the replacement analysis (cost of pump tests and time to analyze them) are usually even less. Groundwater users almost always realize greater savings from conducting a replacement analysis than the cost of the analysis. If significant inefficiencies are discov-ered, energy savings will be substantial. Pumping costs over tha life of a well are usually much reseates the at the usual construction cost. When greater than the well construction cost. When drilling a new well, the most economical design should be chosen instead of the cheapest, if it is financially feasible. (Moore-IVI) W85-00333

NUMERICAL SIMULATION OF THERMAL ENERGY STORAGE EXPERIMENT CONDUCTED BY AUBURN UNIVERSITY,

Waterloo Univ. (Ontario). Dept. of Civil Engineer-

J. F. Sykes, R. B. Lantz, S. B. Pahwa, and D. S. Ward

Ground Water, Vol. 20, No. 5, p 569-576, September-October, 1982. 14 Fig, 2 Tab, 13 Ref.

Descriptors: *Thermal energy storage, *Mathematical models, *Aquifers, *Mobile, *Alabama, Simulation, Water temperature, Thermal convection, Anisotrophy, Thermal conduction, Isotherms,

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Effects On Water Of Man's Non-Water Activities—Group 4C

A multidimensional, finite-difference model for ground-water flow and heat transport is used to analyze the thermal energy storage experiment conducted by Auburn University in Mobile, Alabama. The experiment consisted of three stagesnamely, injection, storage and recovery occurring for 80, 51 and 41 days, respectively. This application demonstrates the validation evidence that the model adequately and accurately simulates the field experiment. The numerical model includes the effects of hydraulic anisotrophy, thermal convection and conduction, and heat loss to the adjacent confining strata. Observed aquifer isotherms at the end of each stage are compared with predicted values on a cylindrical grid situated about the well. The degree of vertical discretization used in the model is shown to impact the predicted temperature profiles at each stage, but has minimal effect on the recovery water temperature. (Author's abstract) thor's abstract) W85-00335

PREDICTION OF ECONOMIC POTENTIAL FOR IRRIGATION USING A GROUND-WATER MODEL, Oklahoma State Univ., Stillwater. Dept. of Geolo-

gy.
D. C. Kent, J. W. Naney, and F. E. Witz.
Ground Water, Vol. 20, No. 5, p 577-585, September-October, 1982. 10 Fig. 5 Tab, 13 Ref.

Descriptors: *Irrigation requirements, *Economic evaluation, *Groundwater depletion, *Mathematical models, Land use, Water potentials, Simulation, Cost-benefit analysis, Cotton, Alfalfa.

The objective of this study is to demonstrate the application of a predictive ground-water potentionetric-head model to estimate the profitability of irrigation in contrast to that of dry-land farming. irrigation in contrast to that of dry-land farming. Unit cost per acre-foot of water required for a variety of crops is used to determine the distributive impact of predicted aquifer depletion at 5-year intervals during 20 years of simulated pumping. A land-use planning scheme is proposed for identifying areas (one square mile or less) where various crop types can be irrigated based on benefit-cost criteria for two arbitrary pumping rates as well as on future energy and well development costs. Maps showing areas of profitable production are presented for cotton and alfalfa as examples of crops requiring as much as 1 and 2 ac-ft/ac/yr (0.30 and 0.60 ha-m/ha/yr), respectively. Irrigation-water needs and related profitability are presented as examples for several crops by using the model. (Author's abstract)

PROSPECT RISK ANALYSIS APPLIED TO GROUND-WATER RESERVOIR EVALUA-

TION,
For primary bibliographic entry see Field 6B.
W85-00341

HYDROGEOLOGIC CONTROL OF LOCALIZED IRON-ENRICHED GROUND WATER, LIMA, OHIO,

Lima, Carasberg. S. I. Strausberg. Ground Water, Vol. 20, No. 6, p 663-667, November-December, 1982. 3 Fig, 7 Ref.

riptors: *Groundwater, *Iron, *Lima, *Ohio, *Hydrogeology, Carbonate aquifers, Permeability, Glacial aquifers, Cooling water, Hardness.

Groundwater pumped from a Silurian carbonate aquifer in northwestern Ohio has been use for industrial cooling at the Lima, Ohio plant of Vistron Corporation. Lateral flow from saturated glacial deposits in an entrenched buried valley under the southwestern part of the Vistron plant site causes localization of high iron concentrations in the groundwater pumped from the carbonate aqui-fer. The high iron concentrations combined with ter. The mgn fron concentrations combined with the hardness of the water have caused deposits on heat exchange surfaces leading to inefficient oper-ations. Pumpage in the Lima region has remained stable from 1971 to 1981 at about 6.6 mgd. Produc-tion wells are open to the carbonate aquifer, having higher permeability than glacial deposits.

Pumping from Vistron's southwesterly operating wells has created a sink that apparently prevents the iron-enriched water, pulled from saturated glacial deposits, from moving towards pumping wells in the central and northern portions of the area. Iron concentrations in water from the southwestern wells are about one order of magnitude higher than in the water from central wells. Iron concentrations in the central and northern wells are not expected to increase as long as about 20% of the plant's groundwater is withdrawn from at least two of the southwestern wells. (Baker-IVI) W85-00342

IMPACT OF LAKE MICHIGAN ALLOCA-TIONS ON THE CAMBRIAN-ORDOVICIAN AQUIFER SYSTEM, Illinois State Water Survey Div., Champaign. A. P. Visocky. Ground Water, Vol. 20, No. 6, p 668-674, Novem-ber-December, 1982. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Water allocation, *Lake Michigan, *Chicago, *Illinois, *Wisconsin, *Cambrian-Ordovician Aquifer, *Groundwater depletion, Water supply, Groundwater supply, Groundwater level, Water shortage, Water demand, Computer models.

Overpumping of the Cambrian-Ordovician aquifer in the Chicago area has caused severe water level declines in portions of Cook, DuPage, Kane, and Will Counties. Recent changes in the accounting procedure for diversion of Lake Michigan water have released more water for public supplies. As communities which have been allocated Lake Michigan water shut off their deep wells, recovery of water levels will occur. The regional cone of depression will continue to spread outward, especially to the west and south. Major cones of depression will shift to Joliet and to the Fox River Valley. At least six pumping centers will expericially to the west and south the control of the Fox River Valley. At least six pumping centers will experience critical water stages along with reduced pumping capacity during the 1980-2020 period. With the additional drawdowns anticipated from Wisconsin pumpages, superimposed on declines predicted by a computer model, it is possible that other areas, especially large pumping centers closer to the State line, might also experience reduced pumping capacity. Computer runs using withdrawals totaling 65 mgd tend to confirm the estimate that even with reduction in deep pumpage brought about through lake allocations, projected estimate that even with reduction in deep pumpage brought about through lake allocations, projected withdrawals will still exceed the sustained yield by 43 mgd. Projected Illinois pumpages will cause as much as 130 feet of additional drawdown along the State line between 1980 and 2020. Wisconsin pumpage is expected to cause an additional 80 feet of decline at the State line over the same period. (Baker-IVI)

METHODS OF FORECASTING AND MAP-PING OF GROUND-WATER TABLES IN THE USSR,

Morton and Partners, Rexdale (Ontario).

E. Zaltsberg. Ground Water, Vol. 20, No. 6, p 675-679, November-December, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Forecasting, *Groundwater level, *Water table, *Mapping, *USSR, Water supply, Mathematical equations, Hydrogeology.

A short description is offered of extensive USSR experience in the field of hydrogeological forecasting in large territories. The composition of the forecast consists of the following stages: collection and analysis of relevant information; choice of predicted tables; calculations of the forecast equations and extremelaring the forecast in the territories and extremelaring the forecast in the territories. predicted tables; calculations of the forecast equations; and extrapolating the forecast in the territory. Periodic hydrological forecasts began to be composed in the USSR about 10 years ago. During this period considerable experience was accumulated in the field of application of various statistical methods of groundwater table forecast purposes, including mapping of existing and predicted regimes. This practice was approved and forecasts were applied by many construction, agricultural, forestry and hydrological organizations and offices. (Baker-IVI) NUMERICAL MODEL STUDY OF GROUND-WATER CONTAMINATION FROM PRICE'S LANDFILL, NEW JERSEY - II. SENSITIVITY ANALYSIS AND CONTAMINANT PLUME SIMULATION,

SIMULATION, Princeton Univ., NJ. Dept. of Civil Engineering. W. G. Gray, and J. L. Hoffman. Ground Water, Vol. 21, No. 1, p 15-21, January-February, 1983. 10 Fig. 1 Tab, 2 Ref.

Descriptors: *Sensitivity analysis, *Groundwater pollution, *Atlantic City, *New Jersey, Landfills, Price's Landfill, Plumes, Simulation, Model stud-ies, Mathematical models, Groundwater move-

A numerical model of flow and transport in the vicinity of Price's Landfill and the Atlantic City public water supply wells is used to estimate the extent of the existing contamination problem. Model parameters such as boundary conditions, Model parameters such as boundary conditions, pumping rates, permeability and dispersivity are varied to demonstrate the sensitivity of the model to these quantities. A historical simulation of the past ten years of contamination is obtained and two schemes of remediation of the contamination problem are compared. Besides providing some insight into the particulars of that specific problem, some of the adequacies and difficulties in applying a numerical simulator have been pointed out. The design of field studies in cooperation with numerical studies will reduce many existing problems of simulation. Finally, the numerical models are not to be confused with tools to be used in place of field studies, but as complements to well designed data collection efforts. (Baker-IVI)

APPLICATION OF A MICROCOMPUTER IN THE ANALYSIS OF PUMPING TEST DATA IN CONFINED AQUIFERS,

Water Surveys (Nigeria) Ltd., Bauchi. J. P. Dumble, and K. T. Cullen. Ground Water, Vol. 21, No. 1, p 79-83, January-February, 1983. 5 Fig. 1 Tab, 7 Ref.

Descriptors: *Drawdown, *Computers, *Confined aquifers, *Pumping tests, Groundwater management, Pumping, Microcomputers, Transmissivity, Water storage, Storage capacity.

By using microcomputers it is possible to rapidly generate the theoretical time drawdown data for a pumping test in a confined aquifer at constant or varying pumping rates for a variety of T (aquifer transmissivity) and S (aquifer storage coefficient) values and including boundary conditions. The ability to graphically display both field and theoretical data on a monitor screen removes the need for manual curve matching, thereby improving the overall interpretation of the test. The capacity of the computer system to quickly treat data gives the hydrogeologist the capability to investigate a large number of possible field conditions, thereby affording a greater insight into the limitations of a solution. (Baker-IVI)

LABORATORY EVALUATION OF GROUND LABORATORY EVALUATION OF GROUND WATER SAMPLING MECHANISMS,
Illinois State Water Survey Div., Champaign.
Aquatic Chemistry Section.
For primary bibliographic entry see Field 5A.
W85-00364

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF URBANIZATION ON PHYSICAL HABITAT FOR TROUT IN STREAMS, Montana State Univ., Bozeman. Dept. of Biology. For primary bibliographic entry see Field 6G. W85-00070

RIPARIAN FORESTS AS NUTRIENT FILTERS IN AGRICULTURAL WATERSHEDS,

New Zealand Forest Service, Rotorua. Forest Research Inst.

Journal of Hydrology, Vol. 21, No. 2, p 98-116, 1982. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Forest hydrology, *Hydrological regime, *New Zealand, *Evergreen forests, Catchments, Forest watersheds, Runoff, Storm runoff, Hydrologic budget, Seasonal variation, Evaporation, Transpiration, Interception.

The water balance, flow frequency, summer low flows, and storm runoff response of four small catchments covered with undisturbed Nothofagus spp.-podocarp-hardwood forest in south Nelson, New Zealand are described. Hard beech and red beech are the dominant forest species, with kamahi, miro, rimu and silver beech as subdominant species. Painfall oradients across the terrain kamahi, miro, rimu and silver beech as subdominant species. Rainfall gradients across the terrain underlain by Moutere Gravel are quite large. Under natural forested conditions, the dissected hill country is only moderately hydrologically responsive compared with similar forested terrain in higher rainfall climates. The influence of the everhigher rainfall climates. The influence of the ever-green forest is most predominant in the evapora-tive components of the water balance, and then principally in the high losses by evaporation of intercepted rainfall. Nearly 30% of gross rainfall is evaporated from interception. Of the estimated 1550 mm mean annual rainfall about 375 mm is cycled between only the exterior of the tree canopy and the atmosphere. Estimated annual tran-spiration forms only 40-45% of the total annual evaporation and is less than the annual net inter-ception loss. The thick, stratified regolith, which novoides substantial catchment storage is important ception loss. The thick, stratified regolith, which provides substantial catchment storage is important in apportioning net rainfall between quickflow and delayed flow and is probably the major factor in moderating the storm runoff response of the Big Bush catchments compared to that in other similar forests. Mechanisms for generating rapid-response runoff are important in small hydrographs and in the early nature of moderating the proposers. the early parts of most large hydrograph responses, but such processes yield much less than half the annual quickflow from the Big Bush catchments and possibly as little as one quarter of the annual quickflow. Rapid response runoff mechanisms generate small hydrographs, but much of the storm runoff in large events is generated by slower re-sponse mechanisms, so that much storm runoff delivered to the stream channels lags 6-24 hours after storm rainfall. (Baker-IVI)

4D. Watershed Protection

FLOODPLAIN MANAGEMENT HANDBOOK. Flood Loss Reduction Associates, Palo Alto, CA. For primary bibliographic entry see Field 6F. W85-00059

CAUSES, CONSEQUENCES AND REMEDIES OF SOIL EROSION IN KENYA,

Kungliga Vetenskapsa (Sweden). Beijerinstitutet. P. O'Keefe. Vetenskapsakademi

io, Vol. 12, No. 6, p 302-305, 1983. 2 Fig, 1 Ambio, Voi. Tab, 16 Ref.

Descriptors: *Erosion control, *Kenya, *Soil erosion, Land management, Semiarid lands, Agricultural runoff, Top soil, Tillage, Farm management, Developing countries.

Erosion problems in Kenya are aggravated by a semi-arid climate over much of the interior of the land, cutting of forests for fuelwood and charcoal-making, and poor land management and agricultur-al practices. In attempts to come to grips with mounting top soil losses, officials are introducing better crop management techniques, coupled to

simple terracing in erosion-prone areas. Critical to the prevention of soil erosion are the protection of soil against direct rain impact and the maintenance of organic matter. In Kenya, subsistence farmers account for some 80% of the population. In most areas, over 50% of these peasants depend on off-farm income opportunities for the major part of their income. The absence of the men on the farms account for the strength of the corn year has created in critical time of the corn year has created. their income. The absence of the men on the farms at certain critical times of the crop year has created labor hardships and reduced the number of individuals able to assist in making changes in agricultural practices. Much future hope is placed in the efforts of zero tillage agriculture. Untilled production reduced erosion by 98% in Nigeria and production reduced evision by 98% in Nigeria and significantly reduced water runoff. Zero tillage also requires less than 10% of the energy and labor input. Zero tillage, however, requires the development of two technologies. Appropriate herbicides and applicators for both pre and post-planting applications are needed as well as punch or injector. and applicators for both pre and post-planting ap-plications are needed as well as punch or injector planters to penetrate the soil. The real issue is a political one: will African governments and donor agencies support these moves which, because they guarantee successful production, will also guaran-tee a more vociferous peasantry. (Baker-IVI) W85-00129

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

QUALITY OF GROUND WATER IN SOUTH-ERN BUCHANAN COUNTY, VIRGINIA, Geological Survey, Richmond, VA. Water Resources Div For primary bibliographic entry see Field 2K. W85-00025

WATER RESOURCES OF THE TULALIP INDIAN RESERVATION, WASHINGTON, Geological Survey, Tacoma, WA. Water Resources Div. For primary bibliographic entry see Field 4B. W85-00030

INVESTIGATION OF MERCURY-AMINO ACID COMPLEXES IN THE AQUEOUS ENVIRONMENT,

Maryland Univ., College Park. Dept. of Chen

C. Po C. Ponnamperuma. Available from the National Technical Information Service, Springfield, VA 22161, as PB84 190412, Price codes: A02 in paper copy, A01 in microfiche. Maryland Water Resources Research Center, College Park, Publication No. 75, August, 1983. 13 p, 3 Tab, 20 Ref. OWRT Project No. A-063-MD (1), Contract/Grant No. 14-34-0001-2122.

Descriptors: Mercury, Sulfhydryl groups, Cysteine, *Oysters, Fluorescence, Heavy metals, Amino acids, Water pollution effects, Toxicity, *Mercury cysteinate, Chromatography, *Pollutant

Mercury is a toxic pollutant which can even at very low levels pose serious environmental prob-lems. Since mercury in solution is known to have a lems. Since mercury in solution is known to have a marked chemical affinity for sulfhydryl groups, we marked encinear affinity for suifhydryl groups, we explored the possibility of mercury entering the biosphere as a mercury-cysteine complex. With the aid of a modified high-pressure-liquid chromatography system, using a fluorescing detection agent, we have established that mercury cysteinate is present in oysters. Most of the mercury was found in the form of mercury cysteinate. in the form of mercury cysteinate. W85-00077

NEW MEDIUM FOR IMPROVED RECOVERY OF COLIFORM BACTERIA FROM DRINKING WATER, Montana State Univ., Bozeman. Dept. of Microbi-

ology. M. W. LeChevallier, S. C. Cameron, and G. A.

Applied and Environmental Microbiology, Vol. 45, No. 2, p 484-492, February, 1983. 2 Fig, 4 Tab,

Descriptors: *Coliforms, *Drinking water, *Membrane filter medium, Bacterial analysis, Filters, Membrane processes, Escherichia, Klebsiella, Citrobacter, Enterobacter.

A new membrane filter medium was developed for the improved recovery of injured coliforms from the improved recovery of injured coliforms from drinking water. The new medium, termed m-T7, consists of 5.0 g of Difco Proteose Peptone no. 3, 20 g of lactose, 3.0 g of yeast extract, 0.4 ml of Tergitol 7 (25% solution), 5.0 g of polyoxyethylene ether W-1, 0.1 g of bromthymol blue, 0.1 g of bromcresol purple, and 15 g of agar per liter of distilled water. In laboratory studies, m-T7 agar also recovered 86-99% more laboratory-injured coliforms than did m-Endo agar. m-T7 agar also recovered an average of 43% more verified coliforms from 67 surface and drinking water samples than did the standard m-Endo membrane filter n did the standard m-Endo membrane filter technique. From drinking water, m-T7 agar recov-ered nearly three times more coliforms than did m-Endo agar. Less than 0.5% of the colonies on m-T7 agar gave false-negative reactions, whereas over 70% of the typical yellow colonies from m-T7 agar produced gas in lauryl tryptose broth. Most of the verified coliforms isolated on m-T7 agar belonged to one of the four common coliform genera: Escherichia, 17.6%; Klebsiella, 21.7%; Citrobacter, 17.3%; Enterobacter, 32.3%. The res demonstrate that m-T7 agar is superior to m-Endo agar, especially for the isolation of injured coli-forms from drinking water. There was no problem with excessive background colonies on m-T7 agar with excessive background colonies on m-T7 agar with the 44 drinking water samples examined. There was some crowding of colonies on the filters of both types of medium when surface water samples containing sewage effluent were examined. The single step membrane filter technique may be used with m-T7 agar for analysis of coliforms in all waters, but anaerobic incubation may facilitate the recovery of coliforms from highly contaminated. recovery of coliforms from highly contaminated surface waters. (Baker-IVI) W85-00103

STATISTICAL VIEW OF HEAVY METAL POL-LUTION INDEX OF RIVER SEDIMENT.

Nippon Inst. of Tech., Saitama. Dept. of Applied

H. Nishida, and S. Suzuki.
Bulletin of Environmental Contamination and
Toxicology, Vol. 32, No. 5, p 503-509, April, 1984.
1 Fig. 4 Tab. 7 Ref.

Descriptors: *Pollution index, *Heavy metals, *Japan, *River sediments, Sediments, Statistical methods, Pollutant identification.

How to set up a standard method for judging as to whether or not river sediment is polluted by heavy metal is essential to the definition of polluted sediments. A new pollution index is proposed which is distributed as noncentral chi-square in most of the cases of practical application. The fundamental philosophy of the method is based on the statistical philosophy of the method is based on the statistical tidea that the upper 1% of the distibution formed by the normalized group of upstream sediment falls within the critical region. The method was tested by studying random samples of upstream sediment not polluted by wastewater and of polluted downstream sediment by means of an Ekman-Burge dredge at ten points from both sides of 92 rivers in Japan. (Baker-IVI) W85-00132

PROBLEMS IN COLLECTION OF REPRESENTATIVE SAMPLES FOR DETERMINATION OF TRIBUTOXYETHYL PHOSPHATE IN POTABLE WATER,

Environmental Health Directorate, Ottawa (Ontarin)

G. L. LeBel, and D. T. Williams.

Jurnal of the Association of Official Analytical Chemists, Vol. 66, No. 1, p 202-203, January, 1983.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants-Group 5A

Descriptors: *Pollutant identification, *Tributox-yethyl phosphate, *Potable water, *Sampling, Raw water, Water analysis, Organic compounds, Phos-phates, Flame retardants.

Tributoxyethyl phosphate (TBEP) is used as a flame retardant plasticizer in many products. Results of a brief investigation on tributoxyethyl phosphate in tap water are presented to illustrate the difficulties in obtaining representative samples and to alert analysts to the importance of designing suitable sampling protocols. Samples were taken of raw water at the intake bay of a treatment plant and of tap water. Large volume samples and extraction were carried out using the AD-2 macroreticular resin method. Grab samples were extracted with methylene chloride. Highly variable levels of TBEP were detected in water sampled from a with methylene chloride. Highly variable levels of TBEP were detected in water sampled from a laboratory tap. Grab samples of water from this tap, after a weekend of non-use, showed very high TBEP levels that decreased as the tap was flushed with water. Potable water grab samples collected from 2 private residences showed increased levels of TBEP in the first-draw samples, a third residence did not show higher TBEP levels. Flushing the taps with 60 L water decreased the TBEP levels to those found in raw water at the treatment plant and in treated water at a pumping station in the distribution system. To provide adequate data for estimating exposure to certain organic compounds it is necessary to analyze both first draw and well flushed tap water samples. (Baker-IVI) W85-00164

DETERMINATION OF TRACE AZAARENES IN WATER BY GAS CHROMATOGRAPHY AND GAS CHROMATOGRAPHY-MASS SPEC-

TROMETRY, Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
R. Shinohara, A. Kido, Y. Okamoto, and R.

Journal of Chromatography, Vol. 256, No. 1, p 81-91, January, 1983. 10 Fig, 2 Tab, 20 Ref.

Descriptors: *Azaarenes, *Aza heterocyclic hydrocarbons, *Gas chromatography, *Resin column, Detection limits, Selected ion monitor, Flame thermionic detectors, Dohkai Bay, Japan, Seawater, Pollutant identification, Mass spectrom-

Various chromatographic techniques have been unsuccessfully employed to detect aza heterocyclic hydrocarbons (azaarenes) in water samples; a detection method with high specificity and sensitivity and a method for concentrating azaarenes in water are required due to their low environmental concentrations. Utilization of a gas chromatography mass spectrometry selected ion monitor detector (GC-MS-SIM) was very useful for the determination of trace azaarenes in environmental samples. Azaarenes in sea water taken from Dohkai Bay in Kitakyushu City were concentrated with an Amherite XAD-2 resin column and separated into azaarenes with two and three rings and those with five rings by a solvent extraction, followed by a clean-up procedure using an alumina column. The azaarenes thereby separated were determined by GC with a flame thermionic detector (GC-FID) and GC-mass spectrometry with a GC-MS-SIM. Detection limits of the azaarenes by GC-FTD were in the range 0.5-3 ng and those by GC-MS-SIM were in the range of 0.02-0.5 ng. (Collier-IVI) W85-00165

MULTI-ELEMENT ANALYSIS OF TRACE METALS IN SOME ENVIRONMENTAL SAMPLES BY SOLVENT EXTRACTION AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY OF METAL CHELATE COM-

Thames Polytechnic, London (England). School of

Chemistry. E. B. Edward-Inatimi.

Journal of Chromatography, Vol. 256, No. 1, p 253-266, February, 1983. 8 Fig, 7 Tab, 17 Ref.

Descriptors: *Trace metals, *High-performance liquid chromatography, *Solvent extraction, *Chelates, Metal complexes, Effluents, River Thames,

England, Plaice, Flounder, Shrimp, Atomic absorption spectrophotometry.

The use of high-performance liquid chromatography (HPLC), after preliminary solvent extraction, for the complete separation of trace amounts of metal chelates prior to their non-selective determination was investigated. A UV detector set to the most intense absorbance peak of the reagent was used as a universal detector for all of the metal chelates at approximately the same sensitivity. Sulfur-containing reagents such as dithizone and diethyldithiocarbamate were used owing to their high absorptivities and because they tend to form strong complexes with toxic metalloids. The absorption mode of HPLC was used, because metal chelates are typically very soluble in non-polar solvents such as chloroform. The high distribution ratios of the complexes in such solvents made possible the use of small volumes for extraction and hence obviated the need for evaporation prior of direct HPLC injection. A buffer medium of pH 8.5 + or - 0.1 gave optimum response for the best vallet in denset at season and HPLC determinated. 8.5 + or - 0.1 gave optimum response for the best multi-element extraction and HPLC determination. Twenty-eight samples of non-ferrous effluent from 19 different manufacturing plants were analyzed using the HPLC method and also using the recommended atomic-absorption spectrometry (AAS): using the HPLC method and also using the recommended atomic-absorption spectrometry (AAS); HPLC can be carried out in 20-30 min, whereas the AAS requires over 90 min due to the extensive sample treatment involved. Water samples were taken from the River Thames at several sampling points; with very little sample preparation, trace metal profiles were obtained and the trace metals present were determined. Concentrations in aquatic biota (plaice, flounder, and shrimps) and in standard kale (Brassica oleracea) as determined by HPLC (preceded by a rapid wet-ashing procedure with nitric acid-hydrogen peroxide) agreeded well with values determined by AAS. (Collier-IVI) W85-00166

RAPID, SENSITIVE, GAS CHROMATOGRA-PHIC DETERMINATION OF DIETHYL MAL-ONATE AND DIETHYL SUCCINATE IN WATER FACILITATED BY SORBENT-TUBE

PRECONCENTRATION, Southern Research Inst., Birmingham, AL. D. R. Coleman, L. M. Rose, W. E. Meyers, and D. R. Coleman, L. M. Rose, W. E. Meyers, and W. K. Fowler. Journal of Chromatography, Vol. 256, No. 2, p 363-367, February, 1983. I Fig, 7 Ref.

Descriptors: *Gas chromatography, *Diethyl malonate, *Diethyl succinate, Preconcentration, Extraction, Dialkyl alkanedioates, Chromatography,

Dialtyl alkanedioates (esters of dibasic acids) are used as plasticizers in the coatings and plastics industry and consequently their presence in the environment must be monitored. A relatively simple, rapid method for the determination of diethyl malonate and diethyl succinate in water was developed based on the vapor-phase pre-concentration of solvent extracts on solid sorbent pre-concentrator tubes and the subsequent thermal desorption of these tubes into a gas chromatograph. At levels corresponding to auguous sample consorption of these tubes into a gas chromatograph. At levels corresponding to aqueous sample concentrations of approximately 3 ng/ml, in order to maximize the sensitivity of the method, the entire sample extract is pre-concentrated. Down to approximately 25 ng/ml, in order to reduce the analysis time and the complexity of routine sample manipulations, only a small portion of the extract is pre-concentrated. The efficiency of extraction was essentially 100% for both analytes using diethyl ether. The relative standard deviation of replicate determinations is typically less than 5% at analyte concentrations is typically less than 5% at analyte concentrations ten (or more) times higher than the working lower limit for quantitative determinations. (Collier-IVI)

ANALYSIS OF TRACE HALOCARBONS IN NATURAL WATERS BY SIMPLIFIED PURGE AND CRYOTRAP METHOD, International Science Consultants, Ringwood

(England).

(Engiana). P. G. Simmonds. Journal of Chromatography, Vol. 289, p 117-127, April, 1984. 3 Fig, 5 Tab, 47 Ref.

Descriptors: *Halogenated hydrocarbons, *Gas chromatography, Cryoloops, Adsorption traps, Permeation dryer, Henry's law, Electron capture detectors, Carbon tetrachloride, Trifluoromethane, Methyl chloroform, Rain, Seawater, Air pollution.

A simplified purge and cryotrap method for the analysis of trace aqueous halocarbons is described. The usual Tenax adsorption trap is replaced with a cryoloop preceded by a permeation dryer which selectively removes water vapor and thereby present traceing in the acrosloop. This long-step! selectively removes water vapor and thereby prevents freezing in the cryoloop. This 'one-step' method reduces potential contamination and is highly sensitive when coupled with capillary electron capture detector analysis of the purged volatiles. Using this method several previously unreported halocarbons have been observed in natural waters (including rain water); many additional halocarbons are observed in all of the water samples compared with samples of the associated ambient air. Henry's law constants were calculated directly yanalyzing both water and ambient air samples collected at the same time. In most cases the water samples were supersaturated with the exception of the following halocarbons: the water/air phases of carbon tetrachloride are close to equilibrium in all water samples analyzed; methylchloroform is close water samples analyzed; methylchloroform is close to equilibrium in rain-water; and trifluoromethane is in equilibrium in sea-water. (Collier-IVI) W85-00168

EXISTENCE OF ANIONIC SURFACTANTS IN RIVER (IN JAPANESE), Kao Corp., Tochigi (Japan). Research Labs. K. Yoshimura, K. Hayashi, J. Kawase, and K. Tsuji.

Japanese Journal of Limnology, Vol. 45, No. 1, p 51-60, January, 1984. 5 Fig, 8 Tab, 19 Ref.

Descriptors: *River sediments, *Water analysis, *Sulfonates, *Anionic surfactants, *Japan, Fatty acids, Fats, Surface water, Sediments, Linear alkyl-benzene sulfonates, Tama River, Ta River, Kinu

Surface water and sediment samples were taken Surface water and sediment samples were taken from several Japanese rivers to analyze for the presence of linear alkylbenzene sulfonates (LAS), fatty acids and fats. Rivers studied include the Tama, Ta, Kinu, and Tenpaku Rivers. LAS determination was carried out by Abbot's methylene blue method and reversed phase high performance liquid chromatography with a fluorimetric detector. After prelabeling of the fatty acids, fatty acids and fats were measured by a reverse phase HPLC with a fluorimetric detector. All river water and sediment samples showed the presence of methylenesses. sediment samples showed the presence of methylene blue active substances, while LAS was not determined in the Tama and Ta Rivers. The concentrations of LAS detected in the river water and sediments of the Tama River were trace-0.38 mg/l sediments of the 1 ama River were trace-0.35 mg/1 and 1.79-10.72 ppm respectively. The concentrations of fatty acids in river water and sediment were 0.005-0.052 mg/1 and 7.7-426 ppm, respectively, and river sediments contained 8-19 ppm of fats. These fatty acids and fats were estimated to be derived from organisms such as algae and bacteria. (Baker-IVI) W85-00191

REEF-BUILDING CORAL SKELETONS AS CHEMICAL POLLUTION (PHOSPHORUS) IN-

Nova Univ. Oceanographic Center, Dania, FL. R. E. Dodge, T. D. Jickells, A. H. Karp, S. Boyd, and R. P. M. Bak.

Marine Pollution Bulletin, Vol. 15, No. 5, p 178-187, 1984. 7 Fig, 4 Tab, 29 Ref. NOAA grant NA

Descriptors: *Phosphorus, *Corals, *Bioindicators, *Bermuda, *St. Croix, *Curacao, Montastrea, Diploria, Calcium, Reefs, Water pollution effects, Seuwater, Wastewater pollution, Endolithic algae.

The inorganic and total phosphorus concentrations of the skeleton of reef-building corals have been determined on specimens from Bermuda, St. Croix, and Curacao. Concentrations determined on subsamples dated by density band growth increments

Group 5A—Identification Of Pollutants

indicate that a record of seawater phosphorus is preserved which, in certain cases, is consistent with the location and time history of sewage and other phosphorus pollution episodes. Concentrations are low with some differences over wide geographic areas and between the two species examined, Montastrea annularis and Diploria strigosa. The record in some specimens shows year to year variability which appears to be related to sewage pollution influence. The method of inclusion of the phosphorus within the skeleton is uncertain. A possibility may be tissue content of endolithic algae. Other sources include trapped detritus, trapped coral tissue and/or organic matrix, and primary deposition. Data from Bermuda suggest that coral phosphorus to Ca ratio is similar to seawater ratios. (Baker-IVI)

USE OF MICROORGANISMS AS GROUND-WATER TRACERS: A REVIEW, Texas Univ. Medical School at Houston. B. H. Keswick, D.-S. Wang, and C. P. Gerba. Ground Water, Vol. 20, No. 2, p 142-149, March-April, 1982. 4 Tab, 49 Ref.

Descriptors: *Groundwater pollution, *Microorganisms, *Tracers, *Bacteriophages, Reviews, Groundwater movement, Path of pollutants, Bacteria, Viruses, Yeasts, Spores, Public health.

The microbial contamination of groundwater is a serious problem that has resulted in large outbreaks of waterborne disease. The ability to trace microbial movement in grounwater is essential in recognizing the potential for transmission of disease-causing microorganisms. Chemical tracers do not always reflect the movement of microorganisms in ground water. Bacteria, viruses, yeasts and lycopodium spores have been used for this purpose and to trace underground movement of water in much the same manner as chemical tracers are used. The use of certain bacteria and animal viruses is undesirable due to their pathogenic potential and difficulties in their differentiation from background, naturally-occurring organisms. Bacterial viruses appear to be the microorganisms most suited as a microbial tracer because of their size, case of assay and lack of pathogenicity. Bacteriophages have been used to trace ground-water movement over distances of 1,600 meters and can be used under a variety of conditions. Because of host specificity, phages can be mixed, injected together, then distinguished on different hosts. (Moore-IVI)

BAILING AND CONSTRUCTION CONSIDER-ATIONS FOR DEEP AQUIFER MONITORING WELLS ON WESTERN OIL SHALE LEASES, Kaman Tempo, Denver, CO.

Raman Tempo, Denver, CO.

K. E. Kelly.
Ground Water, Vol. 20, No. 2, p 179-185, March-April, 1982. 6 Fig, 3 Tab, 5 Ref. EPA contract 68-0302449.

Descriptors: *Monitoring wells, *Oil shales, *Bailing, *Well design, *Piceance Creek Basin, *Colorado, Geohydrology, Water quality, Sampling, Groundwater

Water quality data collected from monitoring wells in the Piceance Creek Basin (Colorado) oil shale area can be significantly influenced by well design and sampling techniques. Many of these influences can be attributed to hydrogeologic complexities, which can have notable variations on a fairly local scale. To adequately address these complexities, a site-specific characterization of the hydrogeology is necessary. This is particularly important for specifying well construction details of monitoring wells for a ground-water quality monitoring program. Data collected during the bailing of deep aquifer wells on Federal Prototype Oil Shale Lease Tract C-a indicates the need for consistent and representative sample collection depths. Appreciable changes in water quality can be induced by variations in sample collection depths. In addition, unrepresentative data can be obtained due to the incorrect selection of intervals to be samples in the well. Care must be taken to sample consistently from the same depth and aquifer interval

during each and every sampling effort. Studies such as these provide necessary background information for developing ground-water monitoring guidelines in the oil shale region. Sampling procedures must be consistent to assure representative data collection. In addition, wells should be designed and completed according to the local hydrogeology and the specific goals of the monitoring program. (Author's abstract)

VADOSE ZONE MONITORING CONCEPTS FOR HAZARDOUS WASTE SITES,

Kaman Tempo, Santa Barbara, CA. L. G. Everett, L. G. Wilson, and L. G. McMillion. Ground Water, Vol. 20, No. 3, p 312-324, May-June, 1982. 2 Fig, 6 Tab, 13 Ref. EPA contract V-7724-NALX.

Descriptors: *Monitoring, *Vadose water, *Hazardous materials, *Waste disposal, Sampling, Groundwater pollution, Water pollution sources.

The implementation of the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) may be enhanced by wider applications of vadose zone monitoring, More than 50 different vadose zone monitoring, techniques are referenced. Fourteen different criteria are established for selecting alternative vadose zone monitoring methods are categorized according to premonitoring techniques, sampling methods and nonsampling methods which could be applied in the vadose zone. Two conceptual cases are presented covering vadose zone monitoring at a hazardous waste disposal impoundment. The rationale for the monitoring program at a new impoundment and for an active impoundment is presented. The material constitutes the first phase of a vadose zone monitoring manual. (Author's abstract)

NEW METHOD FOR SIMULTANEOUS MEAS-UREMENT OF CL(-), BR(-), NO3(-), SCN(-), AND I(-) AT SUB-PPM LEVELS IN GROUND WATER,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Water Resolutes And G. M. Thompson. Ground Water, Vol. 21, No. 1, p 36-41, January-February, 1983. 7 Fig, 1 Tab, 6 Ref. Nuclear Regulatory Commission contract NRC-04-78-275.

Descriptors: *Groundwater pollution, *Anions, *Pollutant identification, Inorganic compounds, Chromatography, Chlorides, Bromides, Nitrates, Iodides, Thiocyanides, Tracers, Chemical analysis.

Ion-exchange high pressure liquid chromatography coupled with a variable wavelength UV detector has proven to be an extemely sensitive and precise method for measurement of a variety of common anions found in natural waters. Sensitivity of measurement is approximately 50 ppb for NO2(-), NO3(-), Br(-), I(-), and SCN(-), while Cl(-) has a detection limit in the one to ten ppm range. Chromatograms require 8 to 13 minutes to complete. Analyses are performed on either of two stationary phases (Whatman SAX 10 microm or Brownlee anion exchange) depending on the anions of interest in the analysis and their interferences. It has been used extensively to measures SCN(-) as a tracer in waters ranging from potable water to chloride-asturated brines. The procedure described has been used very successfully, although to a lesser degree, to measure the remaining anions in natural waters. The analytical equipment has proved to be easily adaptable to field use when operated from a small portable generator. Thus the technique has been ideal for monitoring tracer experiments where real-time data is needed to determine sampling frequencies and to schedule other aspects of the tracing test. By simply changing columns and elunats, this HPLC instrumentation can be used for making measurements of a large variety of organic compounds. (Baker-IVI)

COMPUTER PROGRAM FOR A TRILINEAR DIAGRAM PLOT AND ANALYSIS OF WATER MIXING SYSTEMS.

MIXING SYSTEMS, Kent State Univ., OH. Dept. of Geology. M. D. Morris, J. A. Berk, J. W. Krulik, and Y.

Ground Water, Vol. 21, No. 1, p 67-78, January-February, 1983. 10 Fig. 4 Tab, 2 Ref.

Descriptors: *Groundwater, *Trilinear diagram, *Mixing, *Computers, Water analysis, Path of pollutants, Iron, Aluminum, Silica.

The Piper trilinear diagram (Piper, A. M. 1953. US Geological Survey, Water Res. Div. Ground Water Notes, Geochemistry, No. 12, 14 pp.) has been widely used to graphically represent the dissolved constituents of natural waters and to test for apparent mixtures of waters from different sources. Due to the time needed to plot points and calculate the proportional values of mixing, this treatment of data is often quite tedious, particularly so in studies involving large numbers of chemical analyses. The PIPER program was written in BASIC to be run on a Hewlett-Packard desktop computer with an X-Y plotter. Data input is in ppm units. The program plots points in all three fields of the trilinear diagram, draws at each point within the central diamond field a circle with a radius corresponding to the concentrations expressed in meq/l, checks for points that fall on a straight line representing postulated mixtures with two end members, and/or within a triangle representing mixtures of three end members. The program does a numerical analysis of the mixing ratios of the constituents for postulated mixing systems according to the methodology as presented by Piper. The computer program is based on Piper's original assumptions: all of the major constituents have been included in the calculations; all ions are assumed to remain in solution; all the Fe, Al, and Si are present in the water in a colloidal state as oxides and are not in chemical equilibrium with the ionized constituents thus making it unnecessary to include these elements in calculations of total concentration; minor constituents of pround water are summed with the six major constituents to which they are respectively velated in chemical properties; and water consisting of substantial quantities of free acid cannot be fully represented on the diagram. (Baker-IVI)

LABORATORY EVALUATION OF GROUND WATER SAMPLING MECHANISMS,

Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section. M. J. Barcelona, J. A. Helfrich, E. E. Garske, and

J. P. Gibb. Ground Water Monitoring Review, Vol. 4, No. 2, p 32-41, Spring, 1984. 4 Fig. 10 Tab, 11 Ref.

Descriptors: *Groundwater, *Sampling, Reviews, Pumps, Monitoring, Chemical compounds, Water analysis, Pollutant identification.

The task of obtaining representative samples of ground water in both research and compliance monitoring programs must be carefully approached. Most pumping mechanisms may be expected to perform satisfactorily for well purging and the measurement of solution parameters. Sampling for gas sensitive and volatile chemical constituents can be significantly biased by degassing and loss of volatiles during sample collection. Significant bias and poor precision may be expected in shallow ground water sampling with gas displacement, positive displacement mechanical, and suction mechanisms, unless extraordinary care is taken in sample retrieval, transfer and collection. Bladder (no gas contact) pumps are superior for most applications. The performance of grab samplers, particularly bailers, is heavily dependent on both the expertise of sampling personnel and field conditions. The ideal controlled conditions under which these performance data were collected represent an optimum situation for the observance of minimal sampling error. Field conditions and solution composition are complicating factors that must be evaluated on a case by case basis. (Baker-IVI)

Sources Of Pollution-Group 5B

INDICATOR BACTERIA IN FRESHWATER AND MARINE MOLLUSCS,
Mosul Univ. (Iraq). Dept. of Biology.
M. M. Al-Jebouri, and D. R. Trollope.
Hydrobiologia, Vol. 111, No. 2, p 93-102, April,
1984. 1 Fig. 7 Tab, 26 Ref.

Descriptors: *Mollusks, *Indicator bacteria, Mussels, Clams, Cockles, Coliforms, Fecal bacteria, Water pollution effects, Marine environment, Bioin-

The freshwater mussel Anodonta cygnea and four marine shellfish (mussels, Mytilus edulis; cockles, Cerastoderma edule; clams, Mya arenaria; Scrobi-cularia plana) from a total of six sites were surveyed for Escherichia coli, Clostridium perfingens, fecal streptococci, 25 and 37 C coliforns, 25 C and 37 C total viable numbers and fluorescent pseudomonads. The A. cygnea from an urban lake contained greater numbers of the fecal indicator bacteria than animals from a rural lake. There were also differences in the other bacterial counts and bacteria than animals from a rural lake. There were also differences in the other bacterial counts and these were discussed with respect to bacterial parameter and animal characteristics. When freshwater mussels were transferred from the city site to the rural site for 24 h the load of fecal indicator becteria was eliminated or implicately reduced. bacteria was eliminated or significantly reduced. Other bacterial types took longer to become stabilized. Loss of indicator bacteria from Anodonta lized. Loss of indicator bacteria from Anodonta was also demonstrated using cleansing in the laboratory. Very high bacterial numbers were found in some marine molluscs notably Scrobicularia plana and most shellfish contained significant numbers of the three fecal indicator bacteria at every sampling occasion. The relationship between bacterial types was discussed and it was concluded that in both freshwater and marine animals the bacterial numbers were determined more by sampling site than by species of shellfish. (Author's abstract) W85-00416

COLIFORM CONCENTRATIONS IN LAKE ERIE - 1966 TO 1970, Canada Centre for Inland Waters, Burlington (On-

tario)

S. R. Esterby, and A. H. El-Shaarawi. Hydrobiologia, Vol. 111, No. 2, p 133-146, April, 1984. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Lake Erie, *Coliforms, *Spatial distribution, *Temporal distribution, Fecal coliforms, Water pollution, Indicator bacteria, Clustering, Seasonal variation.

Total coliform concentrations obtained from cruis es of Lake Erie, conducted from the Canada Centre for Inland Waters between 1966 and 1970, have been analyzed to determine the spatial and temporal distribution of total coliforms in the lake. temporal distribution of which and the Although year to year comparisons were made on a qualitative level due to the limitations in the data, some consistent seasonal feature of the spatial distribution are evident. The location of zones of the spatial control of the spatial distribution are evident. The location of zones of the spatial distribution are evident. tribution are evident. The location of zones of higher concentration have been stributed to proximity to large urban areas and lake currents. The contribution of fecal coliforms to the total coliform concentration has been examined with the conclusion that, at the low total coliform concentrations (< or = 30 per 100 ml) observed in much of the lake, there is not relationship between the two concentrations but, over a broader range, fecal coliforms increase with total coliform concentrations and, at very high total coliform concentrations (> or = 1000 per 100 ml), fecal coliforms are always present. The analysis demonstrates 1) the value of examining observed and fitted distributions to compare subsets of a large collection of data and 2) a clustering procedure which is generally applicable to data consisting of counts. (Author's abstract)

5B. Sources Of Pollution

LINCOLNSHIRE LIMESTONE - HYDROGEO-CHEMICAL EVOLUTION OVER A TEN-YEAR

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2F. W85-00017

NITROGEN-ISOTOPE ANALYSIS OF GROUNDWATER NITRATE IN CARBONATE AQUIFERS: NATURAL SOURCES VERSUS HUMAN POLLUTION,
Texas Univ. at Austin. Bureau of Economic Geol-

ogy, C. W. Kreitler, and L. A. Browning. Journal of Hydrology, Vol. 61, No. 1-3, p 285-301, February, 1983. 7 Fig. 3 Tab, 25 Ref. NSF grant DES 74-13560.

Descriptors: *Edwards aquifer, *Texas, *Ironshore Formation, *Grand Cayman Island, *Groundwater pollution, *Nitrates, *Nitrogen isotopes, *Water pollution sources, Isotope studies, Septic tanks, Cesspools, Carbonate aquifers, Aquifers, Animal wastes, Groundwater recharge, Wastewater.

The natural variation of the nitroger isotopes, N-14 and N-15, of groundwater nitrate 'a two carbonate aquifers in different climatic regimes was used as an indicator of groundwater contamination from septic tanks; nitrates derived from different sources are isotopically distinguishable. Results of nitrogen-isotope analyses of nitrate in the waters of the Cretaceous Edwards aquifer in Texas, the sole water supply for the city of San Antonio, indicate that the source of the nitrate is naturally-occurring prirrogen compounds in the recharge streams. In water supply for the city of San Antonio, indicate that the source of the nitrate is naturally-occurring nitrogen compounds in the recharge streams. In contrast, nitrogen isotopes of nitrate in the fresh waters of the Pleistocene Ironshore Formation on Grand Cayman Island, West Indies, indicate that human wastes are the source of the nitrate. Recharge is primarily by streams crossing the fault zone. The delta N-15 of 73 samples of nitrate from Edwards waters ranged from +1.9 to +10 0/00 with an average of +6.2 0/00. This delta N-15 range is within the range of nitrate in surface water in the recharge streams (delta N-15 range = +1 to +11 0/00). No sample was found to be enriched in N-15, which would suggest the presence of nitrate from animal waste (delta N-15 range = +10 to +12 0/00). The Edward's thick unsaturated section and the rapid dilution in the very porous aquifer may be preventing any increased concentration of pollutants. The Ironshore Formation contains a small freshwater lens that is recharged entirely by percolation the contraction of the other stream. Ironshore Formation contains a small freshwater lens that is recharged entirely by percolation through the soil. The delta N-15 of four nitrate samples from water samples of the Ironshore Formation ranged from +18 to +23.9 0/00, which indicates a cesspool/septic-tank source of the nitrate. Limestone aquifers in humid environments that are recharged by percolation through the soil appear to be more susceptible to contamination by septic tanks than are aquifers in subhumid environments that feature thick unsaturated sections and are recharged by streams. (Collier-IVI) W85-00023

ESTIMATION OF NONPOINT SOURCE LOADINGS OF PHOSPHORUS FOR LAKES IN THE PUGET SOUND REGION, WASHING-

Geological Survey, Tacoma, WA. Water Resources Div. R. J. Gilliom.

For Sale by Distr. Br., USGS, 604 S. Pickett St., Alex., Va. 22304. USGS Water Supply Paper 2240, 1983. 24 p, 3 Fig, 7 Tab, 28 Ref.

Descriptors: Lakes, *Eutrophication, Phosphorus modeling, Phosphorus loading, *Mass-balance model *Nutrients, Lake-water quality, Land-use/ water-quality relationships, Nonpoint phosphorus loading, *Washington, Puget Sound region, Pacific Northwest

Control of eutrophication of lakes in watersheds undergoing development is facilitated by estimates of the amounts of phosphorus (P) that reach the lakes from areas under various types of land use. Using a mass-balance model, P-loadings were calculated from present-day P concentrations measured in lake water and from other easily measured physical characteristics in a total of 28 lakes in drainage basins that contain only forest and residential land. The P-loadings from background sources to each of the lakes were estimated by methods developed in a previous study. Differ-

ences between estimated present day P-loadings and loadings from background sources were attributed to changes in land use. The mean increase in annual P yield resulting from conversion of forest to residential land use was 7 kilograms per square kilometer, not including septic-tank system contributions. Calculated P-loadings from septic systems varied, and were found to correlate best with the number of lakeshore dwellings around each lake in 1940. The regression equation expressing this relationship explained 36 percent of the sample variance. For lakes in basis that contain agricultural land, the P-loading attributable to agriculture can be calculated as the difference between the estimated total loading and the sum of estimated loadings be calculated as the difference between the estimated total loading and the sum of estimated loadings from all other (nonagricultural) sources. A comprehensive system for evaluating errors in all loading estimates is presented. The empirical relationships developed allow preliminary approximations of the cumulative impact that development has had on P-loading and the amounts of P-loading from generalized land-use categories for Puget Sound lowland lakes. All the estimates are most suitable for use in developing water-quality goals, setting priorities for lake studies, and designing studies of individual lakes. (USGS) W85-00038

GROUNDWATER: AN INVENTORY OF WELLS AND CONTAMINATION POTENTIAL WITHIN THE SILURIAN AQUIFER OF CALU-MET COUNTY,

Fox Valley Water Quality Planning Agency, Menasha, WI.

For primary bibliographic entry see Field 5G. W85-00055

LONG ISLAND SEGMENT OF THE NATION-WIDE URBAN RUNOFF PROGRAM, Long Island Regional Planning Board, Hauppauge, NY.

December 1982. 134 p, 32 Fig, 75 Tab, 49 Ref, 8

Descriptors: *Urban runoff, *Recharge basins, *Sediment, *Storm water, *Runoff cycles, *Pollution load, Runoff, Natural recharge, Replenishment, Nonpoint pollution sources, Storm runoff, Urban watersheds, Vegetation effects, *New York, Long Jeland.

The question of whether the continued use of the The question of whether the continued use of the Long Island recharge basin, a device for the disposal of runoff and its recharge to groundwater, poses a threat to the quality of the bi-county water supply has caused increasing concern. There was some evidence that the basins were also devices for the concentration of pollutants in runoff and their swift transmission to Long Island's only source of water supply. The results of an investigation into these questions have proved to be largely positive. Coliform and fecal streptococcal bacteria were found in runoff but not in the groundwater beneath the recharge basins. The concentrations of other the recharge basins. The concentrations of other pollutants, which were generally relatively low in pollutants, which were generally relatively low in runoff, were even lower in the groundwater beneath the basins. It appears that infiltration through the soil is an effective mechanism for the attenuation of some of the heavy metals and organic compounds. These findings were as true for the unlined basins as for the recharge basin at Centerach, which was built with a plastic lining. It also appears that, contrary to the widely held view, the removal of vegetation from the basin floor is not necessary, and that the vegetation may actually facilitate the infiltration of storm waters. The findings indicate that some control measures are complex, costly and of questionable effectiveness, and that preventative action precluding degradation is preferable. (Garrison-Omniplan)

OCCURRENCE OF ORGANIC COMPOUNDS IN WATER AND STREAM SEDIMENTS DUE TO THE MT. ST. HELENS ERUPTIONS,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.

Group 5B—Sources Of Pollution

Available from the National Technical Information Service, Springfield, VA 22161 as PB8 190446, Price codes: A06 in paper copy, A01 in microfiche. Washington Water Research Center Report 52, October 1983, 91 p. 9 Fig. 42 Tab, 16 Ref, 3 Append. OWRT Project No. C-10108-V (1458)(1), Contract/Grant No. 14-34-0001-1458 (1).

Descriptors: *Organic compounds, Mudflows, Organic carbon, Water quality, Phenols, Volcanic effects, Sediments, *Mount St. Helens, Water polution sources, Path of pollutants, Pollutant identification, Gas chromatography, *Washington, *Coultie Phine begin in the County of the Princip Page 1981.

Surface and groundwater obtained from the Mount St. Helens area fifteen months after the May 18, 1980, eruption were analyzed by gas chromatography for phenol chlorophenols, polycyclic aromatic hydrocarbons, terpenes, and the haloform potential. Groundwaters outside of the mudflow plain of the North and South Forks and main stem of the Toutsle River, and of the lower Couldtr. River. the North and South Forks and main stem of the Toutle River and of the lower Cowlitz River, showed no measureable quantities (less than one nanogram per liter) of the specific compounds under study. However, wells located on the mud-flow plain were found to contain measurable con-centrations of phenols, chlorophenols, and total dissolved organic carbon. Surface waters con-tained a multitude of dissolved organics. The nature and magnitude of these organics depended on the location within the affected area. Mudflow denoits were found to contain traces of phenols on the location within the affected area. Mudflow deposits were found to contain traces of phenols, while the aged ash did not have detectable amounts of organic material. Continuous leaching column studies of the mudflow deposits revealed a rapid elution of dissolved organic compounds fol-lowed by the tailing of the dissolved organic carbon compounds. W85-00061

DISSOLVED SOLIDS HAZARDS IN THE SOUTH PLATTE BASIN, VOL. II: SALT BAL-ANCE ANALYSIS

Colorado State Univ., Fort Collins. Dept. of Civil

neering.

C. D. Turner, and D. W. Hendricks. Available from the National Technical Information Available from the National Lecturical Information Service, Springfield, VA 22161 as PB84 190099, Price codes: A07 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No. 129, December 1983. 151 p. 14 Fig. 14 Tab, 8 Ref. 3 Append. OWRT Project No. A-051-COLLO (3), Contract/Grant No. 14-34-0001-1106 and 2106.

Descriptors: *Salt balance, *Salinity, Dissolved solids, South Platte, River basin, *Colorado, Salt flows, Salt transport.

The first year of this project assessed the salt flows at five stations of the South Platte River between Henderson and Julesburg, and of the three main tributary streams, the St. Vrain, the Big Thompson, and the Cache la Poudre. The analysis of 15 years of data from 1965-1979 showed that salt is lost from the river between Kersey and Julesburg. The objective of the second year of the project was to require the necessity sets belonge in the was to explain the negative salt balance in the Kersey-Balzac reach and to understand better the mass flows of salt within the system. Another objective was to develop basic data in preparation for development of a salt balance model involving the major components of the lower South Platte system, the long-range objective. Study of the canal diversions in the Kersey-Balzac reach indicated that the reason for the salt imbalance is due to two major canal diversions. These canals transport salt from the Kersey-Balzac reach to agricul-tural lands adjacent to the Balzac-Julesburg reach which, as shown in this analysis, are accumulating salts. This is indicated also by the USBR Narrows study which determined that a water deficit exists for these lands. This would corroborate that these for these lands. Inis would corroborate that these lands may be accumulating salts. Given that these lands have potential for good drainage, which is the general assessment of the USBR, the problem should be alleviated by application of sufficient irrigation water, an objective of the Narrows W85-00063

MEASUREMENTS TO QUANTIFY WASTEWATER FIELDS PRODUCED BY OUT-FALL DIFFUSERS, Michigan State Univ., East Lansing. Dept. of Civil

Richard State Colv., East Zaissing. Sept. of CVA Engineering.

R. B. Wallace, and B. B. Sheff.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190156, Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, August, 1984. 28 p. 12 Fig. 1 Tab, 13 Ref, 1 Append. OWRT Project No. A-123-MICH (1), Contract/Grant No. 14-34-0001-2124.

Descriptors: *Diffusion, Coefficient, Outfall sewers, *Plumes, Wastewater disposal, Stratification, *Stratified flow, Dispersion, Effluents, Path

The behavior of two-dimensional plumes rising through an ambient fluid with a density discontinuity was studied. This system is characteristic of the situation where the ambient stratification has a strong thermocline. Dimensional analysis was used to obtain asymptotic equations which describe plume behavior. A dimension-less parameter relating the location and strength of the density discontinuity and the initial buoyancy flux was found to measure the ability of the density discontinuity to stop plumes rise. Experimental measurements showed the range of values of this parameter where density discontinuity is strong or weak and provided unknown constants for the asymptotic equations so that spreading layer thickness, locaequations so that spreading layer thickness, loca-tion, and effluent concentration can be predicted. The experimental measurements are compared to estimates made using integral equations and the entrainment concept. W85-00067

NONPOINT SOURCE LOADING OF TOXIC SUBSTANCES FROM DECOMPOSING CROP RESIDUE

Maryland Univ., College Park. Dept. of Agrono-

S. Gle

S. Glenn.
Available from the National Technical Information
Service, Springfield, VA 22161, as PB84 190198,
Price codes: A02 in paper copy, A01 in microfiche.
Maryland Water Resources Research Center Publication No. 76, August, 1983. 14 p, 5 Tab, 14 Ref.
OWRT Project No. A-057-MD (1), Contract/
Grant No. 14-34-001-2122.

Descriptors: *Agricultural runoff, Runoff rates, Runoff volume, Cultivation, *Phytotoxicity, Phen-ols, *Decomposing organic matter, Decomposi-tion, Agricultural watersheds, Maryland, *Path of pollutants, Water pollution sources.

Two adjacent, but separate watersheds were equipped to estimate total volume of runoff water and to collect an integrated water samples. One watershed was planted with corn (Zea mays L.) using no-tillage (NT) management and barley (Hordum vulgare L.) as a cover crop. The other watershed was planted with corn using conventional tillage (CT) management. Runoff water sampled between 1979 and 1983 were analyzed for phenolic acids and phytotoxicity to turnip (Brassica rapa L.). The volume of runoff water was reduced with NT management, but the concentration and total loading to phenolic acids were greater in runoff water from the NT watershed compared to that found in runoff water from the CT pared to that found in runoff water from the CT pared to that found in runoff water from the CT watershed. The greatest concentration of phenolic acids were found in runoff water from the NT watershed sampled on 6/18/79 (65.4 ppm, w/v). This sample inhibited radicle growth of turnip 32%. Ferulic acid, caffeic acid, p-hydroxybenzoic acid, o-hydroxyphenylacetic acid, and mandellic acid were isolated and identified from runoff samples. W85-00075

MERCURY IN SWEDISH LAKES - ITS RE-GIONAL DISTRIBUTION AND CAUSES, National Swedish Environment Protection Board, Solna. Water Pollution Research Lab. I. Bjorklund, H. Borg, and K. Johansson. Ambio, Vol. 13, No. 2, p 118-121, 1984. 6 Fig. 38 Descriptors: *Mercury, *Lakes, *Sweden, *Water pollution sources, Heavy metals, Sediment con-amination, Fate of pollutants, Public health, Forest lakes, Air pollution, Pike, Lake acidifica-

The general mercury situation in 220 Swedish Lakes is discussed. None of the lakes receives direct discharges of industrial or municipal sewage effluents. The mercury content of pike, Esox lucius L. was markedly elevated in lakes situated in forest areas in southern and central Sweden. The mean values varied between 0.68 and 0.86 mg Hg/kg for these regions. The highest mean values were found in two areas with major mercury emissions to the air. The natural background level of mercury in fish had been estimated to be 0.05-0.2 mg/kg, but values close to this level were found only in the northern part of Sweden. The generally high mercury content of fish in southern and central Sweden may be caused by an elevated load on the Sweden may be caused by an elevated load on the lakes from increased airborne deposition. Analyses lakes from increased airborne deposition. Analyses of lake sediments indicated mercury concentrations five times higher than the natural load expected in non-polluted areas. This increase seems to have started during the 19th century, though the highest increase has taken place in the 20th century. The advancing acidification of the waters causes an additional increase of the mercury content of fish. It is estimated that the total number of Swedish lakes in which the mercury contents in fish except. It is estimated that the total number of Swedish lakes in which the mercury content in fish exceeds 1 mg/kg is very large, in all probability several thousand. Restrictions on emissions of both mercury and acidifying substances may be effective in reducing the mercury content of fish in the lakes. (Baker-IVI)

INFLUENCE OF SPATIAL AND TEMPORAL VARIATIONS ON ORGANIC POLLUTANT BIODEGRADATION RATES IN AN ESTUARINE ENVIRONMENT,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. G. W. Bartholomew, and F. K. Pfaender. Applied and Environmental Microbiology, Vol. 45, No. 1, p 103-109, January, 1983. 3 Fig, 3 Tab, 16 Pef.

16 Ref.

Descriptors: *Estuarine environment, *Biodegradation, *Water pollution effects, *Temporal distribution, *Spatial distribution, Newport River Estuary, Microorganisms, Cresol, Trichlorobenzene, Chlorobenzene, Nitrilotriacetic acid.

The heterotrophic uptake method of biodegradation assessment was used to evaluate the influence of spatial and temporal variations on pollutant metabolism by natural microbial communities in the Newport River Estuary, located near Morehead City, North Carolina. Three sites were used for the study, representing the gradient from freshwater to estuarine to marine systems. Radiolabeled compounds used as substrates for biodegradation assessments included cresol, chlorobenzene, nitrilotriacetic acid, and 1,2,4-trichlorobenzene. In general the freshwater site demonstrated the highest uptake rates, with somewhat lower rates at the estuarine site. Rates at the marine site were much lower than at the other sites, except during the winter. Metabolic rates at both the freshwater and estuarine areas were significantly decreased during periods of low water temperature. Rates at the marine sites were relatively uniform throughout the year. Linear regression analysis was used to compare m-cresol biodegradation rates to characteristics of the microbial community, which included direct microscopic counts, CFU counts, and cellular incorporation of amino acids. The observed rates did not consistently correlate well with any of the measured characteristics of the microbial community. Findings indicate that for the compounds used, direct measurements of biodegradation rates are needed if the inherent variability of the environment is to be reflected in assessments of pollutant breakdown. (Baker-IVI) W85-00097

ACCUMULATION OF SEDIMENT-ASSOCIATED VIRUSES IN SHELLFISH.

Sources Of Pollution-Group 5B

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment. E. F. Landry, J. M. Vaughn, T. J. Vicale, and R.

Applied and Environmental Microbiology, Vol. 45, No. 1, p 238-247, January, 1983. 1 Fig, 5 Tab, 20 Ref.

Descriptors: "Viruses, "Sediments, "Shellfish, Clams, Oysters, Poliovirus, Bioaccumulation, Bio-logical magnification, Human diseases, Public health.

Epifaunal (Crassostrea virginica) and infaunal (Mercenaria mercenaria) shellfish, placed on or in cores, were exposed to either resuspended or undisturbed sediments containing bound poliovirus type 1 (LSc 2ab). Consistent bioaccumulation by oysters was noted only when sediment bound viruses occurred in the water column. Virus accumulation was noted in only one instance where sediments remained in an undisturbed state. While the incidence of bioaccumulation was therefore higher with resuspended rather than undisturbed contaminated sediment, the actual concentration of accumulated viruses was not significantly different. In the first study with clams, they were placed on mulated viruses was not significantly different. In the first study with clams, they were placed on inoculated cores containing a total of 5980 PFU where they failed to completely burrow into the sediments, leaving their siphons with little proximity to the sediments, being some 6 to 8 cm above the sediment surface. Even so, when pools of four clams were analyzed they contained viruses in average concentrations of 1.60 PFU/50 g. Clams residing in two other inoculated cores failed to accumulate any viruses. In a second trial the clams average concentrations of 1.60 PFU/50 g. Clams residing in two other inoculated cores failed to accumulate any viruses. In a second trial the clams were pushed to the desired depth before virus seeding. After an equilibration period, during which they resumed their normal pumping activities, cores were agitated causing the clams to retract their siphons, and then challenged with virus-seeded sediments. Assay of pooled homogenates again indicated the presence of poliovirus in the clams, suggesting that some potential existed for sediment mediated virus uptake. A 10-fold increase in virus uptake was noted over the first trial, and relegated to the availability of higher concentrations of sediment-bound viruses. In a final trial clams were exposed to sediments containing 1,860 PFU/100 g and no viruses were found in any clam extracts, indicating that proximity to virus infected extracts, indicating that proximity to virus infected sediments does not guarantee bioaccumulation. (Baker-IVI) W85-0009

DISTRIBUTION OF PSEUDOMONAS AERU-GINOSA IN A RIVERINE ECOSYSTEM, Wisconsin Univ.-La Crosse. River Studies Center. S. Pellett, D. V. Bigley, and D. J. Grimes. Applied and Environmental Microbiology, Vol. 45, No. 1, p 328-332, January, 1983. 3 Tab, 34 Ref.

Descriptors: *Pseudomonas, *Public health, *Mississippi River, Ecosystems, Epibacteria, Human diseases, Sediments, Sediment-water interfaces, Antibiotic sensitivity

The distribution of Pseudomonas aeruginosa in navigation pool 8 of the upper Mississippi River was studied by acetamide broth enrichment of water, sediment, and swab (solid-water interface) samples. A total of 152 of the 316 samples collected (48.1%) contained P. aeruginosa. Serological type 1 was predominant (34/2%), followed in order by types 4, 2, 7, 3, 5, and 6. An analysis of pyocin typing data was equivocal. It showed that isolates with similar susceptible indicator strains were clustered in certain serological types and that P. aeruginosa strains in pool 8 were not homogeneous. Antibiotic sensitivity testing revealed that ous. Antibiotic sensitivity testing revealed that only 20 isolates (13.2%) were resistant to carbenicillin and that 1 (0.6%) was resistant to polymyxin cillin and that 1 (0.6%) was resistant to polymyxin. B. None was resistant to gentamicin or to bramycin, and none was multiply resistant. Visible pigmentation on Mueller-Hinton agar was limited to 91 of the 152 isolates. Of these, 68 (44.7%) elaborated typical blue-green pigmentation, 14 (9.2%) produced red pigment, and 9 (5/9%) produced a yellow-green pigment. None of the isolates produced pyomelanin, and 61 (40.1%) were nonpigmented. P. aeruginosa was most commonly isolated from sediment, with solid-water interfaces (auf-

wuchs samples) also exhibiting high frequencies of isolation. Current velocity, oxygen and nutrient availability, surface tension, dessication, and negative phototropism were important factors in the riverine distribution of this epibacterium. (Baker-IVI) W85-00100

LEGIONELLA INCIDENCE AND DENSITY IN POTABLE DRINKING WATER SUPPLIES, Oregon State Univ., Corvallis. Dept. of Microbi-

ology.

D. L. Tison, and R. J. Seidler.

Applied and Environmental Microbiology, Vol. 45, No. 1, p 337-339, January, 1983. 1 Tab, 22 Ref.

Descriptors: *Legionella, *Drinking water, *Water quality, Public health, Human diseases, Water treatment, Chlorination, Filtration, Legionnaires disease, Pontiac fever, Flocculation, Potable water,

The incidence and density of Legionella spp. in water, water at various stages of treatment, in potable distribution water were determined direct immunofluorescence. The four basic es of treatment included water receiving only systates of treatment included water receiving only chlorination and stored in closed reservoirs, water receiving chlorination and stored in open reservoirs, alow sand filtration with chlorination, and water receiving flocculation, mixed media filtration and chlorination. The number of cells reacting with Legionella-specific fluorescent antibody conjugates in raw waters ranged from about 10,000 to 100,000 cells/liter, whereas the concentration of fluorescent antibody-positive cells in the distribution waters were generally 10- to 100-fold lower than in the raw source waters. No viable or virulent Legionella strains were isolated from either the source or distribution waters. However, Legionella spp. are infrequently isolated from water at temperatures below 15 degrees C as was the case in the systems surveyed in this study. The lack of Legionella isolation from the cool water specimens collected during this survey does not premens collected during this survey does not pre-clude occurrences of viable virulent cells in drink-ing water of higher temperatures. (Baker-IVI) W85-00101

ADAPTATION OF NATURAL MICROBIAL COMMUNITIES TO DEGRADATION OF XEN-OBIOTIC COMPOUNDS: EFFECTS OF CON-CENTRATION, EXPOSURE TIME, INOCU-LUM, AND CHEMICAL STRUCTURE,

Environmental Research Lab., Gulf Breeze, FL. J. C. Spain, and P.A. Van Veld. Applied and Environmental Microbiology, Vol. 45, No. 2, p 428-435, February, 1983. 7 Fig. 1 Tab, 9 Ref. EPA contract 68-D1-5043.

Descriptors: *Fate of pollutants, *Degradation, *Microbiological studies, *Xenobiotics, Trifluralin, 2,4-Dichlorophenoxyacetic acid, p-Cresol, Mineralization, Estuarine environment, Marine environment,

Adaptation of microbial communities to faster deg-Adaptation of microbial communities to faster degradation of xenobiotic compounds after exposure to the compound was studied in ecocores. Radiolabeled test compounds were added to cores that contained natural water and sediment. Adaptation was detected by comparing mineralization rates or disappearance of a parent compound in preexposed and unexposed cores. Microbial communities in preexposed cores from a number of freshwater sampling sites adapted to degrade p-nitrophenol faster; communities from estuarine or marine sites did not show any increase in rates of degradation as a result of preexposure. Adaptation was maximal after 2 weeks and was not detectable after 6 weeks. A threshold concentration of 10 ppb was observed. Below this concentration no adaptation was detected. With concentrations of 20 to 100 ppb the biodegradation rates in preexposed cores were much higher than the rates in control cores and were proportional to the concentration of the test compound. Trifluralin, 2,4-dichlorophenoxyacetic compound. Trifluralin, 2,4-dichlorophenoxyacetic acid, and para-cresol were tested to determine whether preexposure affected subsequent biode-gradation. Microbial communities did not adapt to trifluralin. Adaptation to 2,4-dichlorophenoxyace-

tic acid was similar to adaptation to nitrophenol. p-Cresol was mineralized rapidly in both preexposed and unexposed communities. These results would be useful in predicting the fate of the four test compounds if the compounds were released in the river. Trifluralin would biodegrade slowly and at a relatively constant rate, depending on the concentration. p-Cresol would degrade rapidly and immediately, whereas PNP and 2,4-D would persist during adaptation of the microorganisms and then biodegrade rapidly. For PNP and p-cresol the mineralization rates closely parallel rates of parent compound disappearance. This is probably true in most cases where the initial step is rate limiting in a bioegradation sequence that involves complete bioegradation sequence that involves complete mineralization. (Baker-IVI) W85-00102

BACTERIAL ACTIVITY ASSOCIATED WITH THE DECOMPOSITION OF WOODY SUB-STRATES IN A STREAM SEDIMENT,

Oregon State Univ., Corvallis. Dept. of Microbi-J. H. Baker, R. Y. Morita, and N. H. Anderson. Applied and Environmental Microbiology, Vol. 45, No. 2, p 516-521, February, 1983. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Decomposing organic matter, *Stream sediments, *Wood, *Bacteria, Bark, Nitrogen fixation, Microflora, Tannins.

Ground bark and heartwood from Ainus rubra and Pseudotsuga menziesii were added to a muddy sediment from a small Oregon stream and incubated in situ. Carbon dioxide and methane production rates were increased by all amendments, the largest increase being shours with A subra wood. Except increase being shown with A. rubra wood. Except for sediment amended with A. rubra wood, nitro gen fixation rates from all treatments were approxi-mately 0.1 nmol/g per h throughout the 6 month study. Contrary to expectations, neither bark had a noticeable adverse effect on microbial activity, but the A. rubra wood promoted nitrogen fixation. From the combined carbon dioxide and methane evolution rates, A. rubra wood appeared to decay at four times the rate of A. rubra bark, P. menziesii at rour times the rate of A. Tuora oars, r. menziesis wood, and P. menziesii bark. The hypothesis that the slower decomposition of cetain woods is due to the presence of inhibitory substances is not support by these findings. Faster decomposition of A. rubra wood may be related to enhanced N fixation, and tannins in P. menziesii bark were ineffectual. (Baker-IVI) W85-00105

ESTIMATED POLLUTION LOADINGS FROM NORWEGIAN FISH FARMS. I. INVESTIGA-TIONS 1978-1979, Direktoratet for Jakt, Viltstell og Ferskvannsfiske,

A. Bergheim, A. Sivertsen, and A. R. Selmer-Olsen. Aas (Norway).

Aquaculture, Vol. 28, No. 3/4, p 347-361, July, 1982. 2 Fig, 8 Tab, 15 Ref.

Descriptors: *Fish farming, *Water pollution sources, *Norway, Nutrients, Organic matter, Sus-pended solids, Decomposition, Carbon dioxide, Respiration, Oxygen, Nitrogen, Phosphorus, Sodium, Potassium, Magnesium, Calcium.

Water pollution was studied at four inland fish farms in the southeastern part of Norway which produced fingerlings of brown trout and rainbow trout. Concentrations of organic matter, suspended solids and nutrients increased when water passed solids and nutrients increased when water passed through the fish tanks and ponds. The loadings per unit fish biomass varied considerably, mainly as a result of different operational conditions with regard to fish size, feeding routine, water flow and cleaning procedure. The single farm represented a loading corresponding to 30-1260 population equivalents. Production of carbon dioxide due to respiration and decomposing processes may cause respiration and decomposing processes may cause decreased pH in fish ponds and tanks. Reductions of 0.1 to 0.4 pH units were registered. Conductivity was little affected under routine conditions. The lowered concentration of dissolved oxygen at one farm was probably a result of respiration of fish

Group 5B-Sources Of Pollution

and increasing water temperature. The biochemical oxidation course of effluent from fish farms sning dry feed is not unlike that of sewage. Concentrations of organic components in the effluent are closely associated with feeding and cleaning operations. Suspended solids, total N, total P and phosphate-P were also markedly influenced at the farms investigated and the concentrations aftered with organic matter. Increased concentrations aftered with organic matter. Increased concentrations of total N were noted when water passed through fish farms and was caused by contributions of roganic N and ammonia. Concentrations of major cations Na, K, Mg, and Ca were realistic in comparison with the feed supply. Calculations of daily loading indicated considerable pollution potentials due to farming activities. (Baker-IVI)

DISSOLVED SOLIDS HAZARDS IN THE SOUTH PLATTE BASIN, VOL. I: SALT TRANSPORT IN THE RIVER,

Colorado State Univ., Fort Collins. Dept. of Civil

R. V. Gomez-Ferrer, and D. W. Hendricks. Colorado Water Resources Research Institute Completion Report No. 128, December 1983. 186 p, 59 Fig. 25 Tab, 41 Ref, 7 Append. OWRT Project No. A-051-COLO (2), Contract/Grant No. 14-34-0001-1106 and 2106.

Descriptors: *Salt balance, *Salinity, *Salt transport, South Platte, River basin, *Colorado, Dissolved solids, Salt flow, Return flows.

This work demonstrates how river salinity may be characterized, in terms of both time and space variations. Fifteen years of daily and monthly salinity and flow data have been reduced to monthly, seasonal, and annual statistical characterizations for five river stations and three tributary stations for the lower South Platte River. From these characterizations distance profiles were plotted for flow, TDS, and salt mass flows. The distance profiles and measurements of diversion flows, tributary flows, and point source discharges were the basis for a reach-by-reach materials-balance analysis for four reaches of the South Platte River between Henderson and Julesburg. Return flows and return alt mass flows were computed as residuals. The analysis showed that there is not a salt balance in the lower South Platter River. A net salt loss to the land of 380 tons per day occurs by irrigation. The analysis provided can be the basis for a more comprehensive materials balance model. But the results can be used to estimate the impact of new water resources developments upon the salinity regime of the lower South Platte River.

INFLUENCE OF SEDIMENT TYPES ON THE SORPTION OF ENDOTHALL,

North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary hibliographic entry see Field 4A

For primary bibliographic entry see Field 4A. W85-00133

DEPOSITION OF FINE AND COARSE SAND IN AN OPEN-WORK GRAVEL BED, Freshwater Biological Association, Ambleside

(England). For primary bibliographic entry see Field 2J. W85-00148

GEOCHEMICAL PATHWAYS AND BIOLOGICAL UPTAKE OF RADIUM IN SMALL CANADIAN SHIELD LAKES,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

(Manitoos). Presinvater Inst. R. H. Hesslein, and E. Slavicek. Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 3, p 459-468, March, 1984. 4 Fig, 8 Tab, 32 Ref.

Descriptors: *Experimental Lakes Area, *Ontario, *Radium, *Geochemistry, *Bioaccumulation, Calcium, Discrimination factors, Macrophytes, Crayfish, Fish, Sediment contamination, Trout, Sucker, Whitefish, Minnows, Dace, Shield lakes.

Ra-236 occurs naturally in aquatic systems at low concentrations. Its behavior is of concern because of its high radiotoxicity, 1600 yr half-life, and its potential release from uranium mining and nuclear waste materials. The sediment-water interactions and biological uptake of Ra-226 in four small Canadian Shield lakes at the Experimental Lakes Area, Kenora, Ontario were studied. A single addition of Ra-226 was made to each lake between 1970 and 1976. Approximately 90% of the added Ra-226 initially sorbed to the sediments. Outflow from the lakes showed losses of only 5-11% Ra-226 per year. Long-term loss of Ra-226 can be expected to be on the order of 0.5-2% per year as predicted by a water renewal model. Biological uptake and long-term Ra-226 concentrations were measured in three species of macrophytes, crayfish, and five species of fish. Bioaccumulation ranged from 1100 to 500 in macrophytes, 750 in crayfish, from 30 to 80 in large adult lake trout (Salvelinus namaycush), white sucker (Catostomus commersoni), and law whitefish (Coregonus clupeaformis), and from 230 to 1200 in fathead minnows (Pimephales promelas), pearl dace (Semotilus margarita), and northern redbelly dace (Chrosomus cos). Observed Ratio (OR) discrimination factors, (Ra/Ca-sample)/(Ra/Ca-water), in fish fell between 0.011 and 0.032, with the exception of higher values for two dace species and fathead minnows which have higher dietary Ra intake. Ra-236 is favored versus calcium by macrophytes and crayfish. Due to the low Ca concentration in Canadian Shield lakes, and relatively long water residence times, biota have a high potential for radium uptake from mining of uranium deposits that are common in the formation. (Collier-IVI)

FATE OF KEPONE AND MIREX IN THE AQUATIC ENVIRONMENT, Columbia National Fisheries Research Lab., MO. J. N. Huckins, D. L. Stalling, J. D. Petty, D. R.

Buckler, and B. T. Johnson. Journal of Agricultural and Food Chemistry, Vol. 30, No. 6, p 1020-1027, November-December, 1982. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Kepone, *Mirex, *Sediment contamination, *Bioaccumulation, Tissue analysis, Soil bacteria, Minnows, Degradation products, Biodegradation, Pesticide residues, Flame retardants, Little Dixie Reservoir, James River, Missouri, Virginia.

The discovery of Kepone as a degradation product of mirex in the environment has prompted concern about the widespread use of mirex as a flame retardant and pesticide. Fathead minnows were continuously exposed to three concentrations of C-14 Kepone (4, 41, and 380 ng/L) and C-14 mirex (0.04, 3.8, and 33 micro g/L) in flow-through dilutor systems and then placed in fresh water for elimination phases. After 56 days C-14 Kepone residues were concentrated 16,600 times by fathead minnows. However, only 1-5% or 0.1-0.23 micro g/g of these residues was C-14 Kepone. Several observations suggested that some C-14 Kepone residues present in fathead minnows similar exposures of fathead minnows to C-14 mirex resulted in bioconcentration factors as high as 51,400 times. The half-life of C-14 mirex was greater than 28 days in fathead minnows, and no degradation products were detected in whole body samples; concentration factors of C-14 mirex from water varied inversely with mirex water concentration. Hydrosoil samples were obtained from two Kepone conaminated sources: the Little Dixie Reservoir, Columbia, MO, and a tributary of the James River in VA (Bailey Creek). Environmental Kepone residues determined by electron capture gas chromatography averaged 0.38 and 0.54 micro g/g (dry weight) respectively. No evidence of C-14 Kepone or C-14 mirex degradation by hydrosoil microorganisms was observed in anaerobic and aerobic hydrosoil exposures. (Collier-IVI)

DEGRADATION OF NICLOSAMIDE (2',5-DICHLORO-4'-NITROSALICYLANILIDE) IN SEDIMENT AND WATER SYSTEMS, Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst. D. C. G. Muir, and A. L. Varechewski. Journal of Agricultural and Food Chemistry, Vol. 30, No. 6, p. 1028-1032, November-December, 1982. 2 Fig. 5 Tab, 11 Ref.

Descriptors: *Niclosamide, *Bayluscide, *Sorption, *Degradation, *Fate of pollutants, Adsorption, Sediment-water systems, Molluscicides, Piscicides, Perticides, Persistence.

Niclosamide (2',5-dichloro-4'-nitrosalicylanilide) formulated as its ethanolamine salt (Bayluscide) has been used in the Great Lakes for the control of the sea lamprey (Petromyzon marinus), and in tropical regions for control of freshwater snails. C-14 niclosamide degraded rapidly in river and pond sediments (water to sediment ratio 10-20:1) incubated under aerobic and anaerobic conditions over a 128-day period (25 degrees C); half-lives ranged from 1.1 to 3.9 days. Degradation in autoclaved samples occured at a very slow rate, suggesting microbial dependent degradation. The major degradation product was aminoniclosamide (2',5-chloro-4'-aminosalicylanilide), which represented more than 50% of the radioactivity extractable from sediments. Greater amounts of aminoniclosamide were formed under anaerobic conditions (redox potential < 350 mV) than in aerobic systems. A hydrolysis product of niclosamide, 2-chloro-4-introaniline, was also detected but 5-chlorosalicylic acid was not detected in sediment or water extracts. Studies on the adsorption of niclosamide to five different sediments gave an average sediment sorption coefficient (Koc) of 3111 + or -1552. Only 0.3 to 1.7% of the sorbed radioactivity could be desorbed by shaking with water for 24 h. Due to the rapid degradation of niclosamide and aminoniclosamide adsorption. Sorption of niclosamide or aminoniclosamide degradation of niclosamide and aminoniclosamide degradation of niclosamide and minoniclosamide in the environmental fate of niclosamide under field conditons. (Collier-IVI)

BEHAVIOR AND DEGRADATION OF CHLOR-PYRIFOS-METHYL IN TWO AQUATIC MODELS,

Forest Pest Management Inst., Sault Sainte Marie (Ontario).

S. Y. Szeto, and K. M. S. Sundaram. Journal of Agricultural and Food Chemistry, Vol. 30, No. 6, p 1032-1035, November-December, 1982. 4 Tab, 12 Ref.

Descriptors: *Chloropyrifos-methyl, *Fate of pollutants, *Degradation, Sorption, Sediment-water studies, Pesticide residues, Pesticide kinetics, Persistence.

At 15 degrees C, the movement, persistence, and degradation of 400 ppb of chlorpyrifos-methyl in the top 1.5-cm layer of flooded sandy loam soil (model I) and the behavior and degradation of 200 ppb of this chemical in natural water (model II) were investigated for a period of 90 days. In model I chlorpyrifos-methyl was strongly adsorbed on the flooded soil; very little was desorbed and then dissolved in the water. The maximum concentration in the water was I ppb, detected after 0.7 day (16.5 h) of incubation. Chlorpyrifos-methyl degradated readily in the flooded soil. The toxic breakdown product was 3,5,6-trichloro-2-pyridinol, which reached a maximum concentration in about 27 days and declined thereafter. The pyridinol was never detected in the water. Both compounds had almost completely disappeared in 90 days. In model II chlorpyrifos-methyl moved rapidly from the water to the flooded clean soil. After incubation for 13 days, its concentration increased from mondetectable to a maximum of 560 ppb in the top 1.5-cm layer of the soil but decreased from 200 to 40 ppb in the water. Both the parent compound and its breakdown product were degraded readily in soil and water; only 0.1 and 10 ppb remained in the water and in the flooded soil, respectively, after incubation for 83 days. (Author's abstract) W85-00162

Sources Of Pollution-Group 5B

ANALYSIS OF TRACE HALOCARBONS IN NATURAL WATERS BY SIMPLIFIED PURGE AND CRYOTRAP METHOD,

For primary bibliographic entry see Field 5A. W85-00168

TEMPORAL MOMENTS AT LARGE DISTANCES DOWNSTREAM OF CONTAMINANT RELEASE IN RIVERS, Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.

Journal of Fluid Mechanics, Vol. 140, p 153-174, March, 1984. 10 Fig, 18 Ref, 2 Append.

Descriptors: *Path of pollutants, *Temporal moments, *River flow, Temporal distribution, Water pollution control, Discharge siting, Moment equations, Advection, Diffusion, Wastewater disposal, Mathematical equations.

Temporal moments provide a tractable alternative to spatial moments for the theoretical study of contaminant dispersion in rivers, even when the flow is longitudinally non-uniform. Exact analytical results are derived for the time-of-arrival, temporal variance and skewness far downstream of a sudden contaminant release. When the channel varies markedly, there can exist optimal discharge sites which are better than all nearby sites upstream, downstream, or across the flow; it is only by a substantial unstream relocation of the dissites which are better than all nearby sites upstream, downstream, or across the flow; it is only by a substantial upstream relocation of the discharge that the peak concentration level at the monitoring position can be further improved. The advection-diffusion equation is taken to have a form which neglects longitudinal diffusion and averages out the vertical structure. The asymptotic value of the dosage depends only on the volume of contaminant and the river flow rate, so is independent of either the discharge profile or the discharge location. It is only by reducing the volume of contaminant released into the flow that the dosages experienced far downstream can be ameliorated. The lowest pollution levels can be expected when the monitoring (or freshwater extraction) takes place near the bank, even compared with sites slightly downstream. The optimal discharge site can be regarded as taking as much advantage as possible of the downstream region along the shallow bank of low velocity and high shear in which the shear-dispersion process is most efficient. The determination of an optimal site for the extraction of water from the river may take advantage of the protection of forces. cient. The determination of an optimal site for the extraction of water from the river may take advantage of the protection afforded by the efficient dilution along an upstream region of shallow water. There is no worst position for water extraction, nor for discharge; for each cross-section, there is a constrained worst position, but there is improvement if downstream displacement is permitted. (Collier-IVI) W85-00174

DISTRIBUTION OF 137-CS IN SURFACE IN-TERTIDAL SEDIMENTS FROM THE SOLWAY

Research and Training Center, Piran (Yugoslavia).

D. G. Jones, J. M. Miller, and P. D. Roberts. Marine Pollution Bulletin, Vol. 15, No. 5, p 187-194, 1984. 7 Fig, 30 Ref.

Descriptors: *Radioactive wastes, *Cesium radioi-sotopes, *Solway Firth, *Sediment contamination, *Scotland, *England, Fuel reprocessing, Estuarine environment, Water pollution sources, Intertidal

The distribution of 137-Cs from the Sellafield (Windscale) nuclear fuel reprocessing plant has been examined in detail in the surface intertidal sediments of the inner Solway Firth by means of a hovercraft-borne radiometric survey. This survey can be used to identify areas for further in depth investigation based on sampling. Results from the inner Solway Firth show the 137-Cs content of the sediments to be generally in the range of 2-30 pCi/s sediments to be generally in the range of 2-30 pCi/g, with values locally exceeding 50 pCi/g. The highest activities are usually associated with finegrained mud flat and salt marsh sediments, most

widely developed in sheltered coastal embayments. Levels of 137-Cs in inner Solway sediments reflect the falloff of radionuclide content with distance from Sellafield, over 100 pCi/g having been recorded in the outer Solway while intertidal muds from the Ravenglass estuary, about 10 km south of Sellafield, have yielded in excess of 500 pCi/g. (Baker, IV). (Baker-IVI) W85-00201

HEAVY METALS IN BOTTOM SEDIMENTS FROM THE SAW MILL RIVER, WEST CHES-TER COUNTY, NEW YORK, 1981, Geological Survey, Albany, NY. R. J. Rogers. Northeastern Environmental Science, Vol. 2, No. 3/4, p 188-197, 1983. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Bottom sediments, *Heavy metals, *Saw Mill River, *West Chester County, *New York, Grain size, Spatial distribution, Fate of pollutants, Copper, Iron, Zinc, Water pollution sources, Industrial wastes.

Bottom sediments were collected at 20 sites between February and September 1981 to assess the concentration and distribution of heavy metals in the Saw Mill River, which drains a largely urban and industrial area adjacent to New York City. Bottom sediments from six sites were separated into six size fractions to determine the relationship between grain size and metal concentration. Concentrations of seven or more acid-soluble heavy metals were determined in each fraction. Metal concentrations were typically greatest in the less than 63-micrometers (micro m) sediment and decreased with increasing grain size. However, metal concentrations in 1,000- to 2,000-micro m sediment were, in general, higher than in the 250- to 500-micro m and 500- to 1,000-micro m sediment. The 1,000- to 2,000-micro m sediment fraction was selected to study the spatial variation in heavy-metal concentrations because this fraction is least subject to transport and, therefore, a better indicator of source areas. Bottom sediments in the lower 3.0 miles of the river were enriched with copper, lead, and zinc compared to upstream sediments and are considered contaminated. No significant enrichment with iroa or manganese was detected. Significant correlations were found between copper and iron, zinc and iron, and copper and zinc in upstream sediments sediments below river cant correlations were found between copper and iron, zinc and iron, and copper and zinc in upstream sediments but not in sediments below river mile 3.7, which suggests that the sources of metals in the upstream part of the basin differ from those downstream. Concentrations of arsenic, cadmium, chromium, cobalt, mercury, and nickel were, in general, at or below the analytical detection limits in the size fraction studied and therefore could not be excelled. The sediment series that with the state of the sediment series that with the sediment series that we have the sediment series that we have the sediment series that we have the sediment series and sediment series and sediment series are sediments. be evaluated. The sediments enriched with copper, lead, and zinc are in the most heavily industrialized part of the basin. (Author's abstract) W85-00206

SPATIAL VARIATIONS IN PRECIPITATION CHEMISTRY OVER NATAL, SOUTH AFRICA, Hereford Sixth Form Coll. (England).

A. L. Murgatroyd. South African Journal of Science, Vol. 79, No. 10, p 408-410, October, 1983. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Precipitation chemistry, *Spatial variation, *South Africa, *Natal, Sodium, Manganese, Calcium, Potassium, Chorides, Specific con-

Daily samples of precipitation were collected at five locations in Natal over a six month period during the rainy season from October 1979 to March 1980. Two of the localities, the Mouth Edgecombe Sugar Research Station near Durban and the University of Zululand near Empangeni are both about 5 km air distance from the coast. The Cedara Agricultural College near Pietermaritzburg is in central Natal, 80 km from the coast. The remaining two localities are furthest from the coast in western Natal. The Ntabamhlope Agricultural Research Station is near Eastcourt at 160 km from the coast and the Cathedral Peak Forest Research Station is at the foot of the Drakensberg Escarpment 200 km from the coast. A total of more than 200 samples from the five sites were

collected during the summer. Results show a marked decline in the total solute concentration of marked decline in the total solute concentration of precipitation away from the coast. No significant difference between the mean specific conductance of precipitation at Mt. Edgecombe and that at Zululand University was noted even though the two stations are 120 km apart and have very different site conditions. All five of the ions tested (Na, Mg, Ca, K and Cl) declined in concentration away from the coast, but the rate of decline varied in each case. Calcium and potassium increased in relative importance to sodium, chloride, and magnesium away from the coast. On a broad regional scale, distance from the coast appears to be the principal factor determining spatial variations in precipitation chemistry. (Baker-IVI)

COMPARISON OF WATER AND DILUTE ACID TREATMENT ON ORGANIC AND INORGANIC CHEMISTRY OF LEACHATE FROM ORGANIC-RICH HORIZONS OF AN ACID FOREST SOIL,

Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water. E. C. Krug, and P. J. Isaacson. Soil Science, Vol. 137, No. 5, p 370-378, May, 1984. 2 Fig. 4 Tab, 38 Ref.

Descriptors: *Acid rain, *Leaching, *Forest soils, *Acidic soils, Hydrogen ion concentration, Organic matter, Calcium, Magnesium, Aluminum, Soil horizons, Water pollution sources.

Most watersheds considered highly sensitive to acidification by acid rain have high proportions of extremely acid, organic-rich lithic soils and peats. The organic and inorganic chemistry of leachate produced by treating organic-rich horizons of an acid forest soil with distilled-deionized water or with water acidified to pH 3 with H2SO4 was studied. Each soil horizon imparted considerable free and total acidity to the distilled-deionized water through the solubilization of organic matter; the amount and acidic nature of solubilized organic matter was a function of horizon. The amounts of Ca. Mg. and Al in solution were related to the Ca, Mg, and Al in solution were related to the amount of organic matter solubilized. After extenamount of organic matter solubilized. After extensive leaching, material from the Oi horizon was allowed to equilibrate with water, which resulted in considerable further solubilization of organic matter and inorganic constituents and acidification of solution. Leaching with pH 3 H2SO4 produced complex changes in both the organic and inorganic composition of leachate. The amount of Al solubilized was related to soluble organic matter, depending upon the horizon leached. Although it is generally considered that soil organic matter buffers against strong acid additions only by exchange of bases and aluminum for H(+), a number of other mechanisms related to the solubilization of soil organic matter also act to consume H(+). The soil organic matter also act to consume H(+). The understanding of the effects of acid precipitation on shallow, organic-rich soils requires analyses of changes in the chemistry of soluble organic components. (Moore-IVI) ponents. (Moore-IVI) W85-00219

INFLUENCE OF URBAN RUNOFF ON THE WATER POLLUTION OF THE VISTULA IN THE REGION OF CRACOW AGGLOMER-ATION,

Instytut Ksztaltowania Srodowiska, Krakow (Poland). I. Skoczen

Acta Hydrobiologica, Vol. 23, No. 3, p 195-210, 1981. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Vistula, *Krakow, *Poland, *Urban runoff, *Water pollution sources, Urban areas, Bio-chemical oxygen demand, Precipitation, Pollution load, Rainfall runoff.

The Vistula in the Krakow area has an unacceptable level of pollution. Investigations on the influence of urban runoff on the Vistula in the Krakow urban area (agglomeration) were carried out from 1971 to 1976 in 69.1 km of the river course. The BOD5 index was adopted as the basis for the investigation. About 1500 BOD5 determinations

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were made during the six years of the investiga-tion. The annual set of concentrations and loads is not homogenous and does not exhibit a normal distribution. The results obtained during a year were arranged into sets according to meteorologi-cal and hydrobiological criteria. A statistical analy-tic of the set of details and the set of cal and hydrobiological criteria. A statistical analysis of the set for dry periods showed that the results are homogenous and exhibit a normal distribution; sets of loads for precipitation periods do not exhibit a normal distribution. The lowest pollutant load (about 7 thousand tons/year) was found in 1973, a year with low total precipitation. The highest pollutant loads (about 19 thousand tons/year and 17 thousand tons/year) were found in 1974 and 1975, years with high total precipitation. Runoff pollution constituted from 30 to 50% of the total pollution of the Vistula. (Moore-IVI) W85-00222

HEAVY METALS IN THE AQUATIC ENVI-RONMENT OF SOME WATER BODIES OF THE LUBLIN COAL BASIN, Akademia Rolnicza, Lublin (Poland). Dept. of General Chemistry and Agricultural Technology. M. Bubicz, L. Kozak, M. Mikos, and Z. Warda. Acta Hydrobiologica, Vol. 24, No. 2, p 125-138, 1982. 6 Tab, 20 Ref.

Descriptors: *Heavy metals, *Water analysis, *Sediments, *Plants, *Poland, *Lublin Coal Basin, Water pollution effects, Mercury, Cadmium, Lead, Copper, Cobalt, Manganese, Iron, Nickel, Wieprz River, Thysmienica River, Municipal Lake.

River, Thysmienica River, Municipal Lake.

The content of Hg, Pb, Cd, Ni, Co, Cu, Zn, Mn, and Fe in water, bottom sediments, and aquatic plants was determined. The samples of water taken from the rivers Wieprz and Tysmienica and the Municipal Lake contained Hg, Pb, Ni, Co, and Fe in amounts corresponding to concentrations admissible for waters of the purity class I, while the concentration of Cd, Ca and Zn corresponded with values admissible for water of the purity class II. The concentration of the investigated heavy metals in bottom sediments was positively correlated with the content of organic matter. The content of heavy metal implants was highly variable and depended both upon the environment and the species. Some aquatic plants are capable of highly selective accumulation of heavy metals, chiefly of Mn, Fe and Zn. These plants can serve to help clean waters which are polluted with heavy metals and can also be regarded as natural regulators of the concentration of these metals in the aquatic environment. Of the elements determined in plants, only mercury and cadmium were positively correlated with the concentration in water and bottom sediments. (Baker-IVI)

SHORT STUDY OF THE INFLUENCE OF A VALLEY ON THE COMPOSITION OF RAIN-

Central Electricity Generating Board, Ratcliffe on-Soar (England). Scientific Services Dept.

A. Martin. Atmospheric Environment, Vol. 16, No. 4, p 785-793, 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Wales, *Rain, *Valleys, *Hills, Air pollution, Water pollution sources, Nitrates, Sul-fates, Sodium, Hydrogen ion concentration, Ammonia, Topography.

Rainwaters have been sampled weekly for 78 weeks at 6 sites near the sea in mid-Wales, 3 in valley bottoms, 3 on adjacent hilltops. The results were examined for any significant elevational effects and also compared with similar results from a site on the flat east coast of England. Statistically significant evidence was found of regularly increased sea-salt deposition on the hilltops relative to the open ends of the valleys and of spasmodic increased acid deposition in a deep valley bottom relative to a hilltop. On average, 30% less sodium ion was deposited in rain at the open ends of the two valleys compared with the hilltops. It is consistent with the concept of a layer of air carrying sea-salt acrosols lifting from the sea surface to cross the mountains, in contact with the hilltops. On average, 15% more hydrogen ion was deposit-

ed in a deep narrow valley than on the adjacent hillside, 250 m above and 600 m away. In seven of the 13 weeks in which this occurred most clearly, the excess hydrogen ion was accompanied by equivalent of sulfate ion, and in two weeks by equivalent of nitrate ion. This is consistent with (equivalent of nitrate ion. This is consistent with the concept of air rich in sulfur and nitrogen compounds being held below the valley tops until washed out by rain. In the remaining four weeks, there was excess ammonia in the hilltop samples, which reduced the rainwater acidity there but not in the deep valley bottom. Concentrations of ions in rainwater were low in mid-Wales compared with eastern England but the larger rainfall amounts in Wales led to a greater deposition of ions there. (Moore-IVI) W85-00238

FACTORS INFLUENCING TRACE METAL, SULFATE AND HYDROGEN ION CONCEN-

TRATIONS IN RAIN, Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 2K. W85-00241

ATMOSPHERIC TRACE METALS IN THE SNOW LAYERS DEPOSITED AT THE SOUTH POLE FROM 1928 TO 1977,

Laboratorie de Glaciologie et Geophysique de l'Environnement, Grenoble (France). For primary bibliographic entry see Field 2K. W85-00244

ACIDITY OF RAIN IN EUROPE,

Central Electricity Generating Board, Leather-head (England). Central Electricity Research

For primary bibliographic entry see Field 2K. W85-00245

ANALYSIS OF THE CHEMICAL PROPERTIES OF RAIN IN MINNESOTA, Minnesota Univ., St. Paul. Dept. of Plant Patholo-

For primary bibliographic entry see Field 2K. W85-00246

INVESTIGATION OF ACID PRECIPITATION IN QINGHAI PROVINCE, CHINA, East-West Environment and Policy Inst., Honolu-

I Harte Atmospheric Environment, Vol. 17, No. 2, p 403-408, 1983. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Acid precipitation, *China, *Qinghai Province, *Amne Machin Mountains, Urban areas, Hydrogen ion concentrations, Coal combustion, Nitrates, Sulfates, Air pollution, Calcium.

Nitrates, Sulfates, Air pollution, Calcium.

Precipitation and surface water samples from the Tibetan Plateau in Qinghai Province, China, were collected in June 1981, in both small cities with intensive coal burning and highly visible air degradation and in the remote and sparsely populated Amne Machin Mountains on the eastern Tibetan Plateau. A pH measurement in one urban precipitation sample indicated extremely acidic precipitation, with a pH of 2.25. The major acid in the observed event was nitric acid, despite the fact that coal combustion was the major source of local air pollution. The high nitrogen and low sulfate content (0.82% N and 0.08% S) of coal from this region may account partially for the high nitrate-to-sulfate ratio in the precipitation in Machin. In the remote Amne Machin mountains, precipitation pH's did not vary significantly from a value of approximately 6, but levels of calcium, nitrate and sulfate were unexpectedly high. They could have arisen for any of several possible sources, including local dust, pollution from Machin and Xining, pollution from eastern China's industrial and populated areas, and very long distance transport of pollutants from other countries. In all samples for which major anions were measured, including the very acidic urban sample, nitrate concentrations exceeded sulfate concentrations by a wide margin,

despite the dominance of coal burning in the region. (Moore-IVI) region. (Mo W85-00247

INFLUENCE OF HYDROLOGIC CONDITIONS AND SUCCESSIONAL STATE ON DISSOLVED ORGANIC CARBON EXPORT FROM FOREST-

Georgia Univ., Athens. Inst. of Ecology. C. M. Tate, and J. L. Meyer.

Ecology, Vol. 64, No. 1, p 25-32, February, 1983. 4 Fig. 4 Tab, 25 Ref. NSF grants 79-04537 and 80-12093.

Descriptors: *Organic carbon, *Succession, *Forest watersheds, Runoff, Dissolved solids, Pine, Hardwoods, Watershed hydrology, Nutrient export. Forest management.

stration and export of dissolved organic carbon (DOC) were compared in streams draining four southern Appalachian watersheds with different treatment histories in 1969-1970 and again in 1979-1980. In 1969-1970 the watersheds were: old field (1 yr old), hardwood coppice (7 yr old), white pine (13 yr old), and mature hardwood (unwhite pine (13 yr old), and mature nature of the disturbed for at least 45 yr). DOC concentrations disturbed for at least 45 yr). in 1969-1970 were three to four times greater than in 1979-1980 on all watersheds, and the differences in 1979-1980 on all watersheds, and the differences among watersheds were consistent both years: old field > hardwood > pine > coppice. Concentrations were always greater during the growing season. Annual runoff was 50% greater in 1979-1980, and annual DOC export in 1979-1980 was half the 1969-1970 value in all watersheds. Annual export was greatest from the hardwood and old-field watersheds and least from the pine and coppice watersheds during both years. Although there appears to be a trend toward decreasing DOC concentration and export over the first two deconcentration and export over the first two deconcentrations. appears to be a trent toward ucreasing Do-concentration and export over the first two dec-ades of secondary succession, differences caused by periodic variations in runoff are far more signif-icant than any successional changes observed. (Author's abstract) W85-00254

EFFECTS OF WATERSHED DISTURBANCE ON DISSOLVED ORGANIC CARBON DYNAM-ICS OF A STREAM,

Georgia Univ., Athens. Inst. of Ecology. J. L. Meyer, and C. M. Tate.

Ecology, Vol. 64, No. 1, p 33-44, February, 1983. 9 Fig. 3 Tab, 42 Ref. NSF grants 79-04537 and 80-12093.

Descriptors: *Clear-cutting, *Forest watersheds, *Organic carbon, *North Carolina, Forest management, Streams, Ecosystems, Dissolved solids, Base flow, Throughfall, Leaching, Storm seepage,

e response of a stream ecosystem to disturbance in its watershed was investigated by comparing mass balances of dissolved organic carbon (DOC) for a stream draining an undisturbed watershed with a stream draining a watershed that was clearwith a stream draining a watershed that was clearcut 2 yr before the study began. These secondorder streams are in the Coweeta Hydrologic Laboratory, North Carolina. Both streams had similar,
elevated DOC concentrations (from < 1 to 5 mg/
L) during storms. Rising and falling limbs of the
hydrograph also had similar DOC concentrations.
During the growing season DOC concentrations.
During the growing season DOC concentration
increased from headwater seep to the weir in the
undisturbed stream under baseflow conditions. No
significant longitudinal change was observed in the
stream draining the clear-cut watershed. Hence
concentration was consistently lower in baseflow
amples during the growing season in the stream concentration was consistently lower in baseflow samples during the growing season in the stream draining the clear-cut watershed. As a result annual DOC export from the clear-cut watershed was less (9.8-11.5 kg/ha) than from the reference watershed (14.6-15.1 kg/ha). The lower DOC export was partly due to reduced DOC inputs from throughfall and leaching of fresh litter, but most importantly to lower DOC inputs in subsurface water and probably also less in-stream generation of DOC. The rate of recovery of this stream from disturbance is therefore dependent on the rate

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at which the terrestrial system recovers. (Author's abstract) W85-00255

NON-EQUILIBRIUM APPROACH TO MODELING TOXIC METAL SPECIATION IN ACID,

AQUATIC SYSTEMS, Savannah River Ecology Lab., Aiken, SC. T. D. Fontaine, III. Ecological Modelling, Vol. 22, No. 1-4, p 85-100, 1983-1984. 2 Fig, 22 Ref.

Descriptors: "Heavy metals, "Mathematical models, "Heavy metals, "Chemical speciation, "Simulation, "Acidic water, Acid streams, Acid lakes, Kinetics, Fate of pollutants, Path of pollutants, Cadmium, Mercury, Sorption, Cation ex-

A general algorithm (NONEQUI) was developed to simulate the kinetics of sorption and cation exchange processes among heavy metals and substrates in acid (pH < 6.5) lake or stream environments. Because the model is formulated in a kinetic framework, both fast and slow (relative to both the time frames of biological metal uptake and adsorption as well as hydrological residence time) metal substrate reactions can be simulated without incurring computational errors due to the assumption of chemical equilibrium at all times. The model is useful in that it predicts temporal and spatial concentrations of both bound and unbound metals. This is particularly important because it is commonly the unbound species of a metal (e.g., a free divalent cation of cadmium, Cd(2+)) that is its most toxic form. The model was developed for predicting the fate and transport of any divalent A general algorithm (NONEQUI) was developed predicting the fate and transport of any divalent cation including mercury. Important transforma-tions of mercury were included that other cations nons or mercury were included that other cations do not significantly experience: methylation, demethylation, volatilization, and humic acid reduction of Hg(2+) to Hg(0). The latter reaction has potential for significantly affecting the fate, transport, and effects of heavy metals in waters of the southeastern U.S. (Author's abstract) W85-00258

APPLICATION OF RISK AND UNCERTAINTY ANALYSIS TECHNIQUES TO A HEAVY METAL SPECIATION MODEL, Savannah River Ecology Lab., Aiken, SC.

Savannan River Ecology Lab., Aiken, SC. T. D. Fontaine, III. Ecological Modelling, Vol. 22, No. 1-4, p 101-108, 1983/1934. 7 Fig, 1 Tab, 2 Ref. DOE contract DE-AC09-76SR00819.

Descriptors: *Risks, *Uncertainty, *Model studies, *Heavy metals, *Chemical speciation, Simulation, Toxicity, Sorption, Cation exchange, Water pollu-

In every model there is a degree of uncertainty associated with every coefficient that controls the flow of material from one state variable to another. How of material from one state variable to another.

Because of this source of uncertainty, many simulations, each with different (but reasonable) estimates
of coefficient settings should be made so as to
approximate the probable behavior space of the
system of interest. Deterministic models do not
account for variability in output response caused
by uncertain estimates of coefficients. This can
cause their predictions to be of imitted value in by uncertain estimates of coefficients. This can cause their predictions to be of limited value in certain instances. One such instance occurs when trying to simulate the potential risk to the environment that might be incurred as a result of toxic metal inputs. If the uncertainty in coefficients that govern the kinetics of metal sorption and cation exchange reactions with particulate and dissolved substrates is accounted for, a range of values for endpoint concentrations of unbound (toxic) metal species would be expected. Each individual endpoint concentration from the range of simulated values can be tested against a pre-specified threshold concentration level that if exceeded is said to constitute a risk to the environment. If the threshold concentration is not exceeded, then no risk can be said to have occurred. By noting the number of be said to have occurred. By noting the number of times out of the total number of simulations that a risk threshold level is exceeded, the probability of risk can be calculated. Conversely, making an as-sessment of risk based on one endpoint concentra-

tion from a deterministic model gives little insight into the probability of a risk occurring. The degree of risk should be expected to change as our certainty in coefficient estimates increases or decreases. (Author's abstract)

FATES OF AROMATICS MODEL (FOAM): DE-SCRIPTION, APPLICATION, AND ANALYSIS, Oak Ridge National Lab., TN. Environmental Sci-

ences Div. S. M. Bartell, R. H. Gardner, and R. V. O'Neill. Ecological Modelling, Vol. 22, No. 1-4, p 109-121, 1983/1984. 2 Fig. 2 Tab, 22 Ref. DOE contract W-

Descriptors: *Fate of pollutants, *Hydrocarbons, *Polycyclic aromatic hydrocarbons, *Model studies, Bioaccumulation, Degradation, Lotic environment, Lentic environment, Dissolution, Volatilization, Photolysis, Sorption, Anthracene, Naphthalene, Benzo(a)pyrene, Simulation.

The Fates of Aromatics Model (FOAM) evaluates the hypothesis that transport, degradation, and bioaccumulation of polycyclic aromatic hydrocar-bons (PAH's) in aquatic systems can be forecast from fundamental chemical characteristics of this bons (PAH's) in aquatic systems can be forecast from fundamental chemical characteristics of this homologous series of compounds. Molecular weight, ring number, melting point, octanol:water partition coefficient, and a light absorption spectrum are used to calculate rates of dissolution, volatilization, photolytic degradation, sorption, and bioaccumulation of specific PAH's in lotic and lentic environments. FOAM forecast spatial and temporal concentrations of dissolved anthracene within 15 percent of concentrations measured in lotic microcosms. The model overestimated perpectent, but was within 40-50 percent of measured concentrations in stream sediments and papershell clams. Patterns of naphthalene and benzo(a)pyrene flux simulated by FOAM agreed qualitatively with results reported for lentic microcosms. Monte Carlo error analysis of FOAM identified 7 parameters that contributed importantly to imprecision in forecasts of anthracene fate. The rank order of correlation of these parameters with prediction error changes during the course of a simulation. (Author's abstract)

MODELING TRANSPORT PROCESSES AND DIFFERENTIAL ACCUMULATION OF PERSISTENT TOXIC ORGANIC SUBSTANCES IN

SISTENT TOXIC ORGANIC SUBSTANCES IN GROUND WATER SYSTEMS, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science. C. G. Uchrin. Ecological Modelling, Vol. 22, No. 1-4, p 135-143, 1983/1984. 2 Fig, 20 Ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Path of pollutants, *Mathematical models, Sorption, Soil matrix, Differential equa-

The ability to predict the potential spread of groundwater pollution resulting from past and existing sources is of paramount interest for ensuring the potability of this important resource. Trace organic substances are, in general, hydrophobic and do not behave as conventional pollutants. organic suostances are, in general, nytrophotoc and do not behave as conventional pollutants. Their potential for selective association with the particulate matter comprising the soil matrix is quite high. Since the processes of adsorption and desorption are dynamic and not completely reversible, modeling difficulties arise. The conceptual development of several dynamic sorption models is presented, and their relationship to the classical equilibrium partitioning assumption is demonstrated. A numerical algorithm for solving time variable pollutant liquid phase and solid phase concentrations in a soil matrix in three dimensions is formulated so as to be useful for both saturated as well as unsaturated conditions. The technique consists of segmenting the control volume into N segments for which N simultaneous, first-order, ordinary differential equations can be formulated for solute/liquid phase mass balances. Another N simultaneous ordinary differential equations can be

developed for the solute/solid phase mass balances. The liquid phase/solid phase equations are coupled through the reaction term in the liquid phase equations. The resultant is a set of 2N simultaneous ordinary differential equations which can be solved by classical numerical techniques. The algorithm is also useful for multi-dimensional cases, as the segments do not have to be oriented in series. (Moore-TVD) W85,00262

PHYSIO-CHEMICAL AND ECOLOGICAL MODELING THE FATE OF TOXIC SUBSTANCES IN NATURAL WATER SYSTEMS, Manhattan Coll., Bronx, NY. Environmental Engineering and Science Graduate Program.

R. V. Thomann. Ecological Modelling, Vol. 22, No. 1-4, p 145-170, 1983/1984. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Mathematical models, *Fate of pollutants, *Toxic substances, Lake sediments, Food chains, Lakes, Streams, Ecological effects, Ecosys-

The basic mathematical modeling framework for the fate of chemicals discharged into the environment is a complex interaction of chemical kinetics, particle sorption and desorption, sediment interactions, and uptake and transfer in the aquatic ecosystem. The fully time-variable equations do not present any significant insight into the general behavior of chemical fate. Under a steady state assumption and including bottom sediment interactions, relatively simple formulations result that permit rapid calculation of the maximum concentrations that might be expected. For a completely mixed lake, the ratio of the areal loading rate of the toxicant to the water column concentration is determined by the hydraulic overflow rate and the net loss rate of the toxicant from the water column. The steady state food chain model of the accumulations. net loss rate of the loxicant from the water column. The steady state food chain model of the accumulation of a toxic chemical from both water and food sources is a means for estimating the parameters of loss and sediment interaction for a lake. The steady state case of the discharge of a chemical into a stream provides a simple means for estimating net loss rates under some reasonable assumptions. Coupling the food chain model to the physio-chemical model permits the use of chemical concentrations in the fish to estimate the net loss of toxicant in a stream. Examples using data for cadtoxicant in a stream. Examples using data for cadmium in the Sajo River in Hungary and PCB in the Shiawassee fish and sediment appear to confirm the basic model. (Moore-IVI)

MODELLING CONCEPTS FOR HYDROPHO-BIC ORGANIC POLLUTANTS IN LAKES,

Eidgenoessische Anstalt fuer Wasserversorg Abwasserreinigung und Gewaesserschultz, Due bendorf (Switzerland).

Bendon (Switzerland), R. P. Schwarzenbach, and D. M. Imboden. Ecological Modelling, Vol. 22, No. 1-4, p 171-212, 1983/1984. 4 Fig. 4 Tab, 42 Ref, 1 Append.

Descriptors: *Hydrophobic compounds, *Organic compounds, *Fate of pollutants, *Lakes, *Mathematical models, Mixing, Gas exchange, Sorption, Desorption, Particulates, Organic carbon, Photochemical reactions, Limnology.

A simple model concept is developed to evaluate the behavior of hydrophobic organic compounds in lakes. Hydrophobic compounds, defined as being readily soluble in nonpolar organic solvents but only sparingly soluble in water, include important environmental pollutants such as halogenated hydrocarbons, fuel and mineral oil compounds, polycyclic aromatic, hydrocarbons plasticizers, non-ionic detergents, etc. Simple physico-chemical concepts are employed to portray the relevant ransfer and reaction processes: gas exchange is described by the two-film model, sorption/desorption on particulate organic carbon (POC) by a reversible, instantaneous linear sorption isotherm and hydrolysis and photochemical transformations by linear reaction kinetics. Based on the estimation of typical time and length scales for mixing in lakes, the aquatic environments are described

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either by a completely mixed water body (1-box model), or by a annual cycle between stratification (two-box model, consisting of epilimnion and hy-polimnion) and overturn (1-box model). Two test lakes (schematic representations of Lakes Zurich and Biel, Switzerland) and several model comand Biel, Switzerland) and several model compounds, which represent a wide range of typical reaction characteristics, serve to demonstrate how the spatial distribution pattern depends on the relative importance of mixing versus reaction rates. The model is applied to the distribution of tetrachloroethylene (PER) and hexachlorobenzene (HCB) and compared to measured data of PER in Lake Zurich. For compounds dominated by adsorption and removal on particles, a more sophisticated model is needed which includes the exchange between sediments and water. (Author's abstract) W85-00264

ERROR ANALYSIS AND SIMULATION OF MIREX BEHAVIOUR IN LAKE ONTARIO, Centre for Inland Waters, Burlington (On-

Ecological Modelling, Vol. 22, No. 1-4, p 213-252, April, 1983/1984. 18 Fig, 6 Tab, 61 Ref.

Descriptors: *Error analysis, *Lake Ontario, *Simulation, *Fate of pollutants, *Mirex, Public health, Bioaccumulation, Model studies, Niagara River, Oswego River, Lake sediments, Sedimentation, Resuspension, Adsorption.

Mirex enters Lake Ontario from two major sources, the Niagara River and the Oswego River. Since 1968 most has come from the former source. Since 1968 most has come from the former source. Simulation models are employed to quantify the behavior of Mirex in the water column in the biota and in the bottom sediments of the lake. Error analysis was used to indicate areas which need to be investigated with field experiments. Such analysis has indicated environmental and chemical characteristics which control Mirex behavior in the lake. The most important are the bulk density of the sediments and the water sediment exchange processes of sedimentation and resuspension. Adsorption on sediments is so large, variations make relatively little difference. Over the long term, one thousand years and longer, volatilization is an important process of Mirex removal. Mirex is bioconportant process of Mirex removal. Mirex is biocon-centrated. Living organisms influence the medium term distribution (100 years or less). Mirex is very persistent in the lake and most likely will not be persistent in the lake and most likely will not be removed but only buried in the sediments. An exposure analysis demonstrated that even if heavy loading of Mirex stopped, the exposure of living organisms, particularly in the benthos, would remain high. Long term predicted persistance causes it to remain a chronic hazard. The risk to environmental health will continue. Coverage of Mirex contaminated bottom sediment by clean sediments will not be a solution for at least the next 200-500 years. A bioconcentration exposure is definitely evident, whereas biomagnification in the food chain has not been proven. (Baker-IVI) W85-00265

PRELIMINARY MODEL OF THE DISPERSAL AND BIOLOGICAL EFFECT OF TOXINS IN THE TAMAR ESTUARY, ENGLAND, Institute for Marine Environmental Research, Plymouth (England).

J. R. W. Harris, A. J. Bale, B. L. Bayne, R. F. C.

Mantoura, and A. W. Morris. Ecological Modelling, Vol. 22, No. 1-4, p 253-284, 1983/1984. 16 Fig. 3 Tab, 29 Ref. UK Department of the Environment contract DGR 480/683.

Descriptors: *Tamar Estuary, *England, *Fate of pollutants, *Hydrocarbons, *Cadmium, Toxic substances, Estuarine environment, Simulation, Tidal effects, Mussels, Toxicity, Particulates, Adsorp-

A preliminary model of the axial dispersal of toxic substances in Tamar Estuary, a partially-mixed macrotidal estuary in southwest Eagland, is described. The model is based upon a one-dimensional simulation of net solute and particulate fluxes between mid-tidal values. Within this framework,

the losses and partition between dissolved and par-ticle-adsorbed phases of selected aromatic hydro-carbons are calculated. Aromatic hydrocarbons ranging from benzene to benzo(a)pyrene are con-sidered, together with cadmium. As an indicator of biological impact, toxic effects on the mussel, My-tilus edulis, are simulated. Solute dynamics are treated as an advection-diffusion process. Model-ling of particle dynamics incorpostes describing treated as an advection-diffusion process. Modelling of particle dynamics incorporates deposition and resuspension and simulates the observed turbidity maximum at the limit to saline intrusion and the effect of runoff and tidal range on the suspended load of particulates. Hydrocarbon losses by volatilization, photo-oxidation and bacterial action are incorporated. The partition of toxic substances between dissolved and particle-adsorbed phases is assumed in all cases to be reversible and to achieve equilibrium. Chemical speciation of cadmium is treated similarly; competetive binding of humics and particulates by protons and major cations is taken into account. Toxic effects are simulated as acting on the energy balance of Mytilus edulis, via its rates of respiration and absorbtion. The distribution of toxic substances within the simulated estudy of the process of the substances between non or toxic substances within the simulated estu-ary depends critically on the balance between water flows and tidally-driven particle movement, and hence on the partition between dissolved and particle-adsorbed phases. (Moore-IVI) W85-00266

MODELING HEAVY METALS TRANSPORT IN AN ARCTIC FJORD SYSTEM POLLUTED FROM MINE TAILINGS,

Vandkvalitetsinstitutet, Hoersholm (Denmark). Vanda Vanda Vanda V. N. Nyholm, T. K. Nielsen, and K. Pedersen. Ecological Modelling, Vol. 22, No. 1-4, p 285-324, 1983/1984. 18 Fig. 5 Tab, 20 Ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Agfardlikavsa Fjord, *Greenland, *Mine wastes, Particulates, Suspended solids, Sedimentation, Disolution, Fjords, Mathematical models, Wastewater treatment, Pollution load, Water pol-

A computerized mathematical model has been used to describe the dissolution and transport of lead, zinc, and cadmium in the Agfardlikavsa Fjord, Marmorilik, West Greenland, where tailings from Marmorilik, West Greenland, where tailings from the Greenex A/S lead/zinc mine and concentrator are being deposited. The hydraulic model basis is a quasi-stationary box model representation which has been calibrated using salinity profiles. The superimposed metals model assumes equilibrium between dissolved and particulate metal forms between dissolved and particulate metal forms using Langmuir adsorption isotherms to calculate particulate concentrations from concentrations of dissolved metals and suspended solids, respectively. Calibration of the model parameters (sedimentation rates and dissolution rates) has been made observing quite narrow constraints established by constraints and alaboratory experiments. In observing quite narrow constraints established by field observations and laboratory experiments. In the course of the time period being modeled, 1978-1980, the pollution with heavy metals has been mitigated significantly. The abatement measures undertaken include: (i) alteration of the lead flotation process and lime addition to tailings by June/July 1978; (2) alum coagulation of the effluent by January 1979; and (3) establishment of a new tailings discharge system in December 1979. The model has been used to estimate the reductions brought about in inputs of dissolved metals as well as to quantify the dynamics of the heavy metals brought about in inputs of dissolved metals as well as to quantify the dynamics of the heavy metals transport in the fjord system. A particular important objective was to estimate the net outflow of metals to the adjacent Quamarujuk Fjord and to predict how the outflow responded to a decreased pollution load. A further result from the model study was the finding that routine monitoring of soluble metals in the discharged tailings as assayed by a specific method did in fact approximate model estimates of metals discharge rates if pH in the test was changed from pH 7.0 to pH 8.0. (Author's abstract) abstract) W85-00267

INVESTIGATION OF THE HEAVY METAL CONTENT OF SEDIMENTS AND ALGAE FROM THE RIVER NIGER AND NIGERIAN ATLANTIC COASTAL WATERS,

Benin Univ., Benin City (Nigeria). Dept. of Chemistry. C. L. Ndiokwere.

Environmental Pollution (Series B), Vol. 7, No. 4, p 247-254, 1984. 1 Fig. 3 Tab, 25 Ref.

Descriptors: *Heavy metals, *Sediments, *Algae, *River Niger, *Nigeria, Coastal waters, Water pol-lution sources, Arsenic, Gold, Cadmium, Mercury, Nickel, Lead, Tin, Zinc, Oil pollution, Industrial

Trace heavy metals in sediments and green algae from the River Niger and the Nigerian Atlantic coastal waters were examined at four locations: Onitsha, Port Harcourt, Forcados and Warri. The samples, analyzed for As, Au, Cd, Hg, Mn, Ni, Pb, Sb and Zn by NAA (thermal-neutron activation) Sh and Zn by NAA (thermal-neutron activation) and AAS (atomic absorption spectrophotometer) techniques, showed varying degrees of contamination of the sediments by some of the heavy metals. The measured concentrations of As, Cd, Hg and Sb were higher in sediments from the coastal waters than from the River Niger. The sediments from the River Niger contained higher Mn, Pb and Zn concentrations. Similar concentration trends were observed for the algae. Harbor and port activities in the sampling locations may increase the concentration of most heavy metals. Appreciable amounts of some heavy metals may come from the large quantities of crude oil discharged into the coastal waters, creeks and rivers. Urban drainages and small scale industries also contribute to lhigh levels of the trase metals in nearby sediments. The average precision of measurements varied in the average precision of measurements varied in the range of 4.3% to about 10% for most metals. (Moore-IVI) W85-00283

UNDERGROUND TANKS CONTAMINATE GROUNDWATER,

S. Tejada. EPA Journal, Vol. 10, No. 1, p 20-22, January-February, 1984. 1 Fig.

Descriptors: *Groundwater pollution, *Gasoline, *Leakage, Gasoline tanks, Storage tanks, Corrosion, Xylene, Benzene, Toluene, BTX.

Leaking underground gasoline storage tanks are a national problem. The great majority of tanks in use are made of steel, about 1.2 million. Only a small number of them, about 16,000, are protected against corrosion. About 200,000 of the tanks in against corrosion. About 200,000 of the tanks in use are made of fiberglass. Corroded tanks leak slowly, so even a dealer who inventories tank supplies regularly might not detect a leak for a long time. Gasoline floats on top of water, but some of the toxic components dissolve in the water. When gasoline is removed from soil or water, these colorless, odorless components, including benzene, toulene, and xylene, or BTX, remain behind. With passage of the Pipeline Safety Act of 1979 the Dept. of Transportation was authorized to prescribe safety standards and accident reporting requirements for transportation of hazardous liquids in pipelines. The best bet for EPA regulation of underground tanks for storage of non-waste materials such as gasoline and other regulation of underground tanks for storage of non-waste materials such as gasoline and other hazardous substances appears to lie with another law the agency administers, the Toxic Substances Control Act. State and local efforts along with the efforts of industry to curb this problem are consi-derd. (Baker-IVI) W85-00287

RED HERRINGS IN ACID RAIN RESEARCH. Toronto Univ. (Ontario). Inst. for Environmental

M. Havas, T. C. Hutchinson, and G. E. Likens. Environmental Science and Technology, Vol. 18, No. 6, p 176A-186A, June, 1984. 6 Fig, 1 Tab, 76

Descriptors: *Acid rain, *Water pollution sources, Lakes, Fish, Toxicity, Measuring instruments, Land use, Forestry, Agriculture, Runoff, Ecosys-

Sources Of Pollution—Group 5B

Five common misconceptions regarding the effects of acid deposition on aquatic ecosystems are exposed. First: bog lakes have been acidic for thousands of years, thus the acidification of lakes is not a recent phenomenon. The erroneous conclusion here is that all acidification is natural and therefore not of recent anthropogenic origin. Second: the early methods for measuring pH are in error; therefore, no statement can be made regarding historical trends. To combat this claim, various comparison studies of methods for detraining pH have been undertaken. Third: acidification of lakes and streams results from changed land use practices and not acid deposition. Although changes in land use cannot be eliminated entirely as a mechanism for surface water acidification, they cannot explain convincingly the widespread regional acidification of lakes and streams in parts of Scandinavia and eastern North America exposed to acid deposition. Fourth: the decrease in fish populations is caused by over-fishing, disease, and water pollution - not acidification. The opposite conclusion is reached by various studies dealing with the failure of restocking programs, episodic fish kills, correlations between fish populations and pH, characteristic age-class distributions, and distinctive physiological blood parameters. Fifth: because lakes that receive identical rainfall can have considerably different pHs, regional lake acidification cannot be due to acid precipitation. Lakes vary in their susceptibility to acidification based on biogeochemical parameters, surface topography, lake depth, volume, and flushing time. (Baker-IVI) Five common misconceptions regarding the effects

NUTRIENT AND TRACE METAL GEOCHEM-ISTRY OF A DREDGE PLUME, Connecticut Univ., Groton. Marine Sciences Inst. J. M. Tramontano, Jr., and W. F. Bohlen. Estuarine, Coastal and Shelf Science, Vol. 18, No. 4, p 385-401, April, 1984. 10 Fig. 3 Tab, 27 Ref. USN contract N00140-77-C-6536.

Descriptors: *Dredging, *Nutrients, *Trace metals, *Plumes, *Geochemistry, *Thames River, *Connecticut, Estuaries, Resuspension, Suspended sediments, Dissolved solids, Phosphates, Ammonia, Silica, Manganese, Copper, Cadmium, Environmental effects, Water pollution sources.

Field sampling of the dissolved and particulate material field downstream of a large volume bucket dredge operating in the lower Thames River estuary near New London, Connecticut, was conducted in order to examine the magnitude and character of the dredge-induced resuspension. These data indicate that large amounts of dissolved phosphate, ammonia, silica, manganese, copper and particulate materials are released into the water column, whereas cadmium concentrations were unaffected. Concentrations in the vicinity of the dredge exceed background levels by two to nine times for the dissolved materials and by two orders of magnitude for particulates. During the ebb cycle, downstream material concentrations decrease rapidly to background within approximately 180 m for dissolved materials and 700 m for particulates. Two mechanisms were found to control the tales. Two mechanisms were found to control the distribution of materials downstream of the dredge:

(a) physical transport, including advection, turbulent mixing and diffusion, and (b) geochemical processes (i.e. adsorption, desorption, precipitation, dissolution, etc.). The concentration of dissolved dissolution, etc.). The concentration of dissolved materials downstream of the dredge at a first order exponential rate. The downstream distribution of the dissolved ammonia and silica was found to be consistent with the reactivity experiments which predicted that PO4 would undergo a decay in concentration in the presence of suspended sediments. Absorption of phosphate onto suspended sediments and gravitational settling of the suspended particulates were the processes. Manganese and copper underwent a dual transformation which involved an initial dissolution, followed by flocculation and possible coprecipitation as MnO2. Cadmium concentrations in the water column were unaffected by the dredging process due to low pore water concentrations. The observed spatial distribution indicates that dredge-induced injection of dissolved and particulate materials is primarily a near field phenomenon producing relatively minor variations as compared to those caused by natural-

ly occurring storm events. These latter systems have been shown to produce estuary-wide variations in suspended materials, PO4 and NH4 concentrations increasing the mass of materials in suspension by at least a factor of two. This increase in total suspended load, PO4 and NH4, is nearly an order of magnitude larger than that produced by the dredge. (Author's abstract)

COMPLEXATION OF TRACE METALS BY ADSORBED NATURAL ORGANIC MATTER, Geological Survey, Miami, FL. Water Resources

J. A. Davis. Geochimica et Cosmochimica Acta, Vol. 48, No. 4, p 679-691, April, 1984. 11 Fig, 4 Tab, 26 Ref.

Descriptors: *Trace metals, *Adsorption, *Organic matter, *Complexation, Chemical speciation, Alumina, Colloids, Natural waters, Copper, Cadmium, Fate of pollutants.

Adsorption is significant in regulating the concentration of dissolved trace metals in natural waters. Modeling approaches for adsorption have been based on studies on colloidal hydrous oxides in the absence of organic matter. The adsorption behavior and solution speciation of Cu(II) and Cd(II) were studied in model systems containing colloidal alumina particles and dissolved natural organic matter. At equilibrium a significant fraction of the alumina surface was covered by adsorbed organic matter. Cu(II) was partitioned primarily between alumina surface was covered by adsorbed orgenic matter. Cu(II) was partitioned primarily between the surface-bound organic matter and dissolved Cu-organic complexes in the aqueous phase. Complexation of Cu(2+) with the functional groups of absorbed organic matter was stronger than complexation with uncovered alumina surface hydroxplexation with uncovered alumina surface hydroxyls. The complexation of Cu(II) by adsorbed organic matter can be described by an apparent stability constant approximately equal to the value found for solution phase equilibria. Cd(II) adsorption was not significantly affected by the presence of organic matter at the surface, due to weak complex formation with the organic ligands. Models of particle/trace element interactions which are based on the surface chemistry of clean hydrous oxides may not be directly applicable to natural systems. The suspended particle concentration in many natural waters is low enough that a large percentage of the surface area may be covered with organic matter. (Moore-IVI) W85-00296

HYDRAULIC CONDUCTIVITY OF A FINE-GRAINED TILL, CATTARAUGUS COUNTY, NEW YORK,

Geological Survey, Carson City, NV. For primary bibliographic entry see Field 2F. W85-00305

FLY ASH DISPOSAL IN A LIMESTONE QUARRY, nn Geoscience Corp., Camphill, PA.

J. R. Peffer. Ground Water, Vol. 20, No. 3, p 267-273, May-June, 1982. 5 Fig, 11 Ref.

Descriptors: *Fly ash, *Quarries, *Water pollution sources, *Groundwater pollution, *Pennsylvania, Water table, Land disposal, Sulfates, Alkaline

Approximately 740,000 tons (670,000 metric tons) of eastern bituminous coal fly ash were deposited at the abandoned Zullinger limestone quarry (Pennsylvania) from 1973 to 1980. The quarry (Pennsylvania) from 1973 to 1980. The quarry extended below the water table and was not lined to isolate the ash from the aquifer. The initial filling involved dumping ash directly into the quarry waster. The quarry was situated in folded and fractured limestone with relatively high solution-void permeability. Ground-water quality was monitored at the site for seven years through a network of wells. During the first three years of the filling operation, high levels of sulfate were detected in downgradient ground water. However, this initial pollution diminished sharply in 1976 when the ash filled the volume of the quarry below

the water table. Long-term ground-water pollution has apparently not resulted. The lack of any significant long-term impact on ground-water quality is attributed to the low permeability of the ash relative to the surrounding limestone aquifer. Typical-type the surrounding limestone aguifer. by alkaline limestone ground water at the site is also attributed with neutralizing the low pH fly ash which was deposited. (Author's abstract) W85-00309

INVESTIGATION OF ALDICARB IN GROUND WATER IN SELECTED AREAS OF THE CENTRAL SAND PLAIN OF WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Geology and Geophysics. E. R. Rothschild, R. J. Manser, and M. P.

Anderson. Ground Water, Vol. 20, No. 4, p 437-445, July-August, 1982. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Aldicarb, *Groundwater pollution, *Wisconsin, Pesticide residues, Path of pollutants, Water pollution sources, Carbamate pesticides,

The systemic pesticide aldicarb is applied in the potato furrow during planting. Its primary use in Wisconsin is to protect potatoes form the Colorado potato Beetle and nematodes. The goal of this study was to provide a preliminary assessment of the occurrence and movement of the pesticide aldicarb in ground water in the Central Sand Plain of Wisconsin. Aldicarb concentrations in ground water beneath three main study fields and two subsidiary fields were monitored during the period water beneath three main study nests and two subsidiary fields were monitored during the period December 1980 to August 1981. A total of 67 well points, some nested, and one multilevel sampler were installed for this study. Twenty-five private wells and seven irrigation wells were sampled. The highest concentrations of aldicarb were detected in the second of the s nighest concentrations of aldicarb were detected in shallow monitoring wells (those located immediately below the water table; no aldicarb was detected in any of the deep monitoring wells (those located roughly 60 feet below the water table), although aldicarb was found in some of the irrigation wells finished at approximately the same depth. Aldicarb seems to be concentrated in roughly a 5-foot layer near the water table. The presence of aldicarb in shallow groundwater is due in part to the highly water achieved. ly a 5-foot layer near the water table. The presence of aldicarb in shallow groundwater is due in part to the highly water-soluble nature of this pesticide. The presence of aldicarb in a few of the deep irrigation wells was probably a result of local vertical flow components near the pumping well. The detection of aldicarb in a few shallow private wells downgradient from some fields demonstrates the mobility of this contaminant in groundwater. This pesticide is a good indicator of potential groundwater contamination by other organics because it is highly soluble and poorly adsorbed; in this sense it represents a worst case contaminant. (Moore-IVI)
W85-00324

NATURE AND SOURCE OF ARSENIC IN NORTHEASTERN OHIO GROUND WATER, Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences, G. Matisoff, C. H. Khourey, J. F. Hall, A. W. Varnes, and W. H. Strain.

Ground Water, Vol. 20, No. 4, p 446-456, July-August, 1982. 7 Fig, 34 Ref. OWRT grant A-061-OHIO.

Descriptors: *Arsenic, *Groundwater pollution, *Canal Fulton, *Ohio, *Water pollution sources, Methane, Glacial till, Hydrogen ion concentration, Redox conditions, Adsorption equilibrium, Ferric

Elevated arsenic concentrations were found in ground water near Canal Fulton, Ohio. The hydrologic and chemical properties of the area were studied to determine the source of the arsenic and evaluate the possibility of a similar problem occurring elsewhere. Two major aquifer systems exist within the study area: the Sharon Sandstone of the upland areas; and the outwash sand and gravel deposits of the buried valleys. Ground-water flow is generally from the north, but local variations are caused by the Tuscarawas River valley on the

Group 5B-Sources Of Pollution

south and west of the study area. Within the study area, there is no evidence for an anthropogenic source of arsenic to the ground water. Agricultural soils, abandoned underground coal mines, industrial impoundments to the north, and an abandoned al impoundments to the north, and an abandoned industrial dump site within the study area were all eliminated as possible sources for the arsenic. The arsenic in Canal Fulton ground water is entirely inorganic, consisting of about equal parts of arsenate and arsenite. Reduction-oxidation (redox) considerations suggest that arsenic is controlled by an adsorption equilibrium with ferric hydroxides, and that the reduction of the ferric hydroxides by a secent lowering of Elip and for plut in the activities has and that the reduction of the territe systemates by a recent lowering of Eh and/or pH in the aquifer has liberated both iron and arsenic to solution. A high correlation between ferrous iron and total dis-solved arsenic supports this model. It is hypothe-esized that Eh conditions have been lowered in the aquifer by either the recent introduction of methaquifer by either the recent introduction of methane gas or the deposition of a thick layer of till during the last glacial retreat. The methane gase could be leaking from deep underground storage at the site and reducing oxidized compounds. The deposition of till would have eliminated local recharge of oxygenated waters. (Author's abstract) W85-00325

NITRATE DISTRIBUTION IN THE GROUND WATER OF THE ALLISTON REGION OF ON-TARIO, CANADA, York Univ., Toronto (Ontario). Dept. of Geogra-

phy. A. R. Hill. Ground Water, Vol. 20, No. 6, p 696-702, November-December, 1982. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Fertilizers, *Ontario, *Alliston, Path of pollutants, Agriculture, Wells, Water pollution sources.

Analysis of groundwater samples from wells and springs indicates that several major areas of nitrate contamination occur within the shallow aquifer near Alliston, Ontario. Nitrate-N concentrations under potato fields often exceed 10 mg/l, whereas concentrations of less than 1 mg/l are characteristic of groundwater under areas of forest and permanent pasture. Regression analysis revealed a sig-nificant positive correlation between nitrate-N concentration in groundwater and the average rate of fertilizer nitrogen application in the 1977-80 period. A significant positive association between ground water chloride concentration and rates of potassium chloride fertilizer application together with consistent Cl/NO3-N ratios in ground water under potato fields also suggests that fertilizers are the major source of nitrate in the aquifer. Eight wells located adjacent to heavily fertilized potato fields had very low nitrate-N concentrations. In contrast to the majority of wells, these 8 penetrated to more than 20 ft below the water table. The likelihood that low nitrate-N concentrations occur in the deeper portion of the aquifer requires further study. If the presence of a widespread zone of low nitrate-N concentrations could be confirmed in the murate-ry concentrations could be confirmed in the Alliston area, it may be possible to alleviate problems of high nitrate levels in domestic water supplies by constructing wells which extend to a greater depth below the water table. (Baker-IVI) W85-00347

APPROXIMATING POLLUTANT TRANSPORT TO GROUND WATER,

Robert S. Kerr Environmental Research Lab., Ada, OK. C. G. Enfield, R. F. Carsel, S. Z. Cohen, T. Phan,

and D. M. Walters. Ground Water, Vol. 20, No. 6, p 711-722, November-December, 1982. 3 Fig. 5 Tab, 35 Ref.

Descriptors: *Groundwater pollution, *Solute transport, *Model studies, Pesticides, Degradation, Aldicarb, DDT, Path of pollutants.

Three models are presented for estimating transport of organic chemicals though soils to ground-water. The models consider mobility and first order degradation. The first model calculates line order degradation. In this model calculates linear sorption/desorption of the pollutant and first order degradation without considering dispersion. The second is similar but also considers dispersion. The

third considers nonlinear sorption following a Freundlich equation and first order degradation but does not consider dispersion. The models are compared to field data for the pesticides aldicarb and DDT. Based on the correlation between field data and an experimental projections the arreach should be and DDT. Based on the correlation between field data and model projections the approach should be adequate to make environmental decisions evaluating the potential hazard of nonionic organics to the ground water. Modification to one of the equations would be necessary to evaluate ionic or charged compounds. The sensitivity of the model to degradation rate shows the need to describe degradation and the parameters affecting degradation accurately. Each of the models has certain advantages, and the appropriate model should be selected based on individual need. (Baker-IVI)

NUMERICAL MODEL STUDY OF GROUND-WATER CONTAMINATION FROM PRICE'S LANDFILL, NEW JERSEY - I. DATA BASE AND FLOW SIMULATION,

Princeton Univ., NJ. Dept. of Civil Engineering. W. G. Gray, and J. L. Hoffman. Ground Water, Vol. 21, No. 1, p 7-14, January-February, 1983. 8 Fig. 1 Tab, 11 Ref.

Descriptors: *Water quality control, *Groundwater pollution, *Atlantic City, *New Jersey, Aquifers, Landfills, Data collections, Geohydrology, Model studies

Toxic waste is currently threatening to contaminate the public water supply wells for Atlantic City, New Jersey. The geohydrologic data for this region are presented and organized into a two dimensional modeling study of the flow in the upper zone of the Cohansey formation in the serious of the contamination problem. The study of the contamination problem. upper zone of the Cohansey formation in the region of the contamination problem. The study as described is strictly a modeling exercise. For two dimensional transient flow, prime aquifer parameters for simulation of the head configuration are the storage coefficients and the transmissivity. A pump test was conducted on the Atlantic City Municipal Supply Well No. 4 in 1981. The well was pumped at 580 gpm for 36 hours. Drawdown in the upper Cohansey during the pumping period was noted at several nearby wells. A Thiem type analysis was performed. The primary region of interest in this modeling study is the portion of the upper Cohansey formation in the vicinity of Price's Landfill. Presentation of the data in light of numer-Landfill. Presentation of the data in light of numer-ical work reveals the importance of good estimates of boundary conditions, historical pumping records, reliable water quality data, accurate well logs, and reasonable parameter estin W85-00353

GROUND WATER CONTAMINATION OF TWO PRODUCTION WELLS: A CASE HISTO-

RY, Ecology and Environment, Inc., Seattle, WA. For primary bibliographic entry see Field 5F. W85-00363

GROUND WATER MONITORING AT A SEP-TAGE LAGOON FACILITY IN CONNECTI-

Geotoxi Associates, Inc., Glastonbury, CT. B. L. Morton, J. J. Kolega, and H. D. Luce. Ground Water Monitoring Review, Vol. 4, No. 2, p 45-50, Spring, 1984. 3 Fig. 2 Tab, 11 Ref.

Descriptors: *Groundwater monitoring, *Connecticut, *Lagoons, Wastewater treatment, Nitrogen, Nitrates, Chlorides, Monitoring wells.

Current design guidelines in Connecticut for septage lagoons stipulate that they be constructed in a two cell, series configuration. Lagoon sidewalls and bottoms generally consist of excavated earthen material with a 30 cm layer of medium sand, and bottoms generally consist of excavated earthen material with a 30 cm layer of medium sand, ranging in grain size from 0.25 to 0.60 mm, placed on the bottom to facilitate sludge removal. Monitoring studies indicated that in general natural water table elevations were found to be at their highest during the late part of February and early part of March. Chloride concentrations in the perinheral monitoring well array have been consistence. ripheral monitoring well array have been con

ently below 10 mg/l except for one point located to the west of the secondary treatment lagoon. Chloride levels beneath the septage lagoon have been generally elevated above background levels. been generally elevated above background levels. From the outset of lagoon operation, the nitrogen contribution from the septage cell to the ground water has been primarily in the form of ammonium nitrate. The assumption that nearly complete nitrification occurs within the 1.22 m separation distance required between the base of the lagoon and the water table was not confirmed during the study period. Ammonium-nitrogen concentrations in the ground water immmediately below the primary lagoon have averaged 86.9 mg/l. It is speculated that the ammonium-nitrogen transformations observed were due to ground water advection processes. (Baker-IVI)

LANDFILL LEACHATE MIGRATION AND ATTENUATION IN THE UNSATURATED ZONE IN LAYERED AND NONLAYERED COARSE-

Wisconsin Dept. of Natural Resources, Madison. R. A. Gerhardt. Ground Water Monitoring Review, Vol. 4, No. 2, p 56-65, Spring, 1984. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Landfills, *Groundwater pollution, *Attenuation, *Leachates, *Sauk County, *Wisconsin, Aeration zone, Lysimeters, Soil water, Path of pollutants.

Two natural attenuation landfill sites, one near Prairie de Sac in Sauk County, Wisconsin, and the other near Reedsburg, also in Sauk County were selected for study. Leachate and soil-moisture samples were collected from the refuse and the unsaturated soils by means of pressure-vacuum lysimeters. The observed concentrations of the leachates, or any leachate component, at depth in the unsaturated zone beneath the landfills have apparently resulted from the interaction of several factors: the chemical quality of the leachates being entry resulted from the interaction of several fac-tors: the chemical quality of the leachates being produced within the refuse material; chemical interactions between the soil and the leachate; and unsaturated soil moisture/leachate movement. The attenuation of leachate within the unsaturated zone was observed beneath the Sauk County and Prairie due Sac landfills. However, ground water beneath both sites was contaminated. The limited attenu-ation capacity of the unsaturated sands and gravels ation capacity of the unsaturated sands and gravels beneath the two sites was apparently incapable of preventing ground water contamination. Operating the landfills as natural attenuation sites did not prevent ground water contamination. Sampling with one or two lysimeter nests in the unsaturated zone may not be indicative of the actual ground. zone may not be indicative of the actual ground water contamination potential of a landfill, as evidenced by this study. In the case of layered soils in the unsaturated zone, the possibility of horizontal leachate movement must also be considered. At the Prairie du Sac landfill, leachate was detected in the unsaturated zone at least 15.2 m beyond the fill limits. (Baker-IVI) W85-00366

EXPERIMENTAL STUDY OF THE STRUCTURE OF A FRESHWATER-SALTWATER INTERFACIAL MIXING (ETUDE EXPERIMENTALE DU MELANGE A L'INTERFACE EAU-

SAUMURE), Hydraulics Research Station, Wallingford (England).

For primary bibliographic entry see Field 2L. W85-00387

5C. Effects Of Pollution

BIOACCUMULATION STUDY ON HOMARUS AMERICANUS.

O'Brien and Gere Engineers, Inc., Syracuse, NY. Final Report to U.S. Army Engineer District, New York, April, 1979. 52 p, 6 Tab, 41 Ref, 1 Append.

Descriptors: *Bioaccumulation, *Biochemical characteristics, *Biochemical tests, *Accumulation, *Chemical analysis, *Lobsters, *Tissue analysis,

Effects Of Pollution-Group 5C

*Municipal wastes, Industrial wastes, Dredging, Ocean dumping, Crustaceans, *New York, New

One method of determining man's impact on the marine ecosystem is to assess the bioaccumulation of contaminants by organisms indigenous to areas of interest. The American lobster, Homarus americanus, is a generalized marine predator of the ocean floor and, as such, has the potential to accumulate contaminants from its immediate habitat. It is also a highly sought-after food fish, which could present toxicologic problems. As of 1970, the commercial catch averaged approximately 30 million pounds. In addition to the Ocean Disposal Site for Dredged Material, three alternate sites were chosen to study whether ocean disposal of dredged material is substantially enhancing bioaccumulation in lobsters. Contributing factors at each site included ship traffic and associated discharges and spills; sewage effluent; wind-carried debris; cellar dirt and industrial wastes; and other factors related to an urban environment. Ten samples were taken from each site. All but one petroleum hydrocarbon and all DDT concentrations were below detectable values. PCBs, mercury and cadmium were found in all 40 samples. Bioaccumulation of PCBs, Hg and Cd was found to a higher degree at the Gravesend Bay location than at the other three. Further evidence of bioaccumulation was demonstrated by the correlations between body weight and tissue concentration. Tissue con-One method of determining man's impact on the was demonstrated by the correlations between body weight and tissue concentration. Tissue con-tamination accumulated at the Gravesend Bay site, the Disposal site, and the Long Island Control site are most likely site specific. (Garrison-Omniplan) W85-00045

APPLICATION OF THE BIOTAL OCEAN MONITOR SYSTEM TO A STUDY OF THE IMPACTS OF OCEAN DUMPING OF DREDGED MATERIAL IN THE NEW YORK BIGHT

Tereco Corp., College Station, TX.
W. E. Peguegnat, B. M. James, E. A. Kennedy, A.
D. Fredericks, and R. R. Fay.

Technical Report prepared for the Department of the Army Corps of Engineers, New York District, January 1980. 48 p, 7 Fig, 9 Tab, 17 Ref, 2 Append.

Descriptors: *Bioaccumulation, *Ocean dumping, *Biochemical characteristics, *Municipal wastes, *Mytilus, *Killfish, *Clams, *Accumulation, *Biochemical tests, *Waste disposal, Lead, Heavy metals, Cadmium, Lead, Mercury, Ocean bottom, *New York, New York Bight.

A limited biological monitoring study was conducted at the Mud Dump Site and environs in New York Outer Harbor and the Bight Apex, using biotal ocean monitors of the benthic type B-BOMS. Each of the B-BOMS was loaded with the fish Fundulus grandis; the bivalve mollusks Myti-lus edulis and Mercenaria mercenaria; the shrimp Palaemonetes pugio; and the worm Nereis sp. All except the worm were used in subsequent laboratory tests. Analyses were run on three metals: cadmium, mercury, and lead. The only significant in-crease in cadmium occurred in Fundulus at the crease in cadmium occurred in Fundatus at the Mud Dump Site and Gravesend Bay. Some lowering of concentrations occurred in both Mytilus and Mercenaria, but both of these bivalves have very high natural levels of cadmium. Results of the mercury analysis suggest that tissue accumulation of this metal occurred in Mercenaria at the Mud of this metal occurred in Mercenaria at the Mud Dump Site. The only statistically significant tissue accumulation of lead occurred in Mytilus in the B-BOMS but not in the BOMS of the pelagic type deployed in the Mud Dump Site and in Gavesend Bay. Several toxic chlorinated hydrocarbon pesticides were found in Fundulus, Mytilus, and/or trapped Cancer irroratus. Among the more toxic of these were the cyclodiene companies aldring. trapped Cancer irroratus. Among the more toxic or these were the cyclodiene compounds aldrin; DDT, DDD, DDE; and such others as BHC and lindane. In addition, PCBs in the form of Arochlor 1254 were found in all organisms tested. In Fundulus grandis exposed in B-BOMS for 10 days PCB burdens ranged from .079 to .287 pp. (Garrison-trapped from .079 to .287 pp. ...) Omniplan) W85-00051

EFFECTS OF FRESHWATER RUNOFF ON NEARSHORE TROPICAL MARINE FISHER-

Caribbean Research Inst., St. Thomas, VI. M. J. Canoy, J. Beets, F. D. Martin, and B.

weichert.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 190214, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 16, September 1983. 57 p, 7 Fig. 10 Tab, 19 Ref, 3 Append. OWRT Project No. A-017-VI (1), Contract/Grant No. 14-34-0001-

Descriptors: *Runoff, Production, Plankton, Fisheries, Tropical waters, Fish larvae, Primary productivity, *Virgin Islands, *Finfish, *Marine fish-

A study was done to determine the relationship of freshwater runoff to breeding conditions, reproduction, and larval ecology of common nearshore marine fishery species. Finfish of the families Anchoa, Engraulidae, Culpeidae, Gobiidae, and Syngnathinae were found to reach peaks in the inchythoplankton about 6-8 weeks after heavy rains; however on two occasions peaks, occurred without rains. The numbers of surviving fish larvae appears greater during plankton blooms following nutrient-rich runoff.

CALIBRATING EFFECTS OF ACIDITY ON AT-LANTIC SALMON FOR USE IN HABITAT SUITABILITY MODELS,

Maine Cooperative Fishery Research Unit, Orono.

Maine Cooperative Fishery Research Unit, Orono. J. G. Trial, and J. G. Stanley.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190065, Price codes: A03 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, February 1984. 37 p, 1 Fig. 9 Tab, 45 Ref. 1, Append. OWRT Project No. A-054-ME (1), Contract/Grant No. 14-34-0001-0121, -1121, -2121.

Descriptors: *Acid rain, *Carrying capacity, *Fish management, Habitats, *Model testing, *Salmon, Streams, Model studies, *Acidity, *Habitat Suitability Index, Water quality, Water pollution effects, *Hydrogen ion concentration.

A Habitat Suitability Index model for Atlantic salmon was developed as a method for predicting reductions of habitat quality caused by acid precipitation. 18 suitability curves describing density and survival of Atlantic salmon as a function of habitat variables were developed from published information. Of the 18 variables, 5 dealt with water quality, 3 with each of the life stages spent in freshwater (fry and parr), and 7 with reproduction (spawning and embryo development). Stream pH was a variable in both water quality and reproduction. Effects of pH on other model variables were studied. Experiments at three levels of pH from 5.0 was a variable in both water quality and reproduction. Effects of pH on other model variables were studied. Experiments at three levels of pH from 5.0 to 6.0 had no effect on the temperature or oxygen levels selected by parr, demonstrating that the 3 variables independently affect fish. Thus, a limiting factor model was used in aggregating variables of water quality. Field observations suggest that depth, velocity, and substrate for fry and parr should be combined using geometric means, because the variables were compensatory. Laboratory studies of the effects of low pH on swimming performance of salmon fry led to modification of the original suitability curve for velocity, such that velocities greater than 30 cm/sec were unsuitable if average pH was less than 4.5. The models are based on the assumption that the index of habitat quality is directly proportional to carrying capacity. To test this assumption and the sensitivity of this model to the effects of acidification, 1982 salmon populations were correlated with HSI values calculated from measurements in 3 streams of differing pH. The model predicted reduced carrying capacity of Atlantic salmon in one stream because of the effect of pH on embryo survival. The HSI value calculated by including pH data was 70% lower than that calculated without considering pH. HSI values including pH data did not correlate with standing crops, whereas the HSI's produced without pH data did (p = 0.8). Howev-

er, one estimate of Atlantic salmon standing crop may not be indicative of carrying capacity. W85-00068

HYPOXIC STRESS IN COPEPODS.

Maryland Univ. Baltimore County, Baltimore. Dept. of Biological Sciences.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190420, Price codes: A02 in paper copy, A01 in microfiche. Maryland Water Resources Research Center, Col-Harymin water Resolutes Research Center, College Park, Publication No. 81, August 1983. 17 p, 5 Tab, 17 Ref. OWRT Project No. A-067-MD (1), Contract/Grant No. 14-34-0001-2122.

Descriptors: *Oxygen, *Dissolved oxygen, *Cope-pods, *Water temperature, *Hypoxia, *Stress, Tol-erance.

Lowering oxygen levels in the water lowered tolerance to high temperatures in copepods. Tolerances to high temperature and to low oxygen did not seem to be the same trait physiologically but may be related genetically. Females were more tolerant than males to hypoxia; acclimation to temperature increased tolerance to hypoxia and there seemed to be genetic variation in tolerance at both high and low oxygen levels. Slight changes in oxygen levels at critical temperatures, within the range experienced in nature, markedly affected the copepods. was-00078

RIOU MORT, A TRIBUTARY OF THE LOT POLLUTED BY HEAVY METALS, III, GENER-AL FAUNISTIC STUDY (LE RIOU MORT, AF-FLUENT DU LOT, POLLUE PAR METAU LOURDS, III. ETUDE FAUNISTIQUE GENER-

Toulouse-3 Univ. (France). Lab. d'Hydrobiologie.

Annales de Limnologie, Vol. 19, No. 1, p 29-43, 1983. 9 Fig, 4 Tab, 29 Ref.

Descriptors: *Riou Mort, *France, *Ecological effects, *Oligochaetes, *Lot, *Aquatic animals, Water pollution effects, Species diversity, Heavy metals, Population density.

The Riou Mort, a river strongly degraded by domestic and industrial effluents, is characterized by a marked organic pollution, a high turbidity, the presence of heavy metals and sudden variations of pH and O2 content in relation to regular discharges. This pollution is examined here from the faunistic approach by two methods: the total study of the fauna and the study of parameters that summarize the faunistic data (density, number of taxa, index of Bournand and Keck). The two methods give similar results and can he used to describe taxa, index of Bournand and Keck). The two methods give similar results and can be used to describe the changes in the environment. The second method is the simplest and quickest, and a general faunistic study appears superfluous in such cases of gross pollution. Likewise, it is sufficient to consider the total oligochaetes only because very little additional information is obtained from their specific identification. (Author's abstract)

DYNAMICS OF CONTRIBUTION OF NITRO-GEN AND PHOSPHORUS TO THE RIVER AVEYRON (DYNAMIQUE DES APPORTS EN NUTRIENTS AZOTES ET PHOSPHORES A LA

RIVIERE AVEYRON), Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Res-sources Renouvelables.

Sources Renouvelaties. E. Chauvet, M. Prat, and J. N. Tourenq. Annales de Limnologie, Vol. 19, No. 1, p 51-58, 1983. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Aveyron, *France, *Nitrogen, *Phosphorus, *Eutrophication, Water pollution effects, Aquatic plants, Water pollution sources, Denitrification, Watersheds, Slope.

The upper reaches of the Aveyron show obvious signs of eutrophication. Even in the lotic zones, the

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periphyton (mostly benthic diatoms) and the aquatic macrophytes indicate the effects of the nutrient levels. Physical-chemical data were collected at 15 stations on the Aveyron from October 1979 through September 1980. The water chemistry, with generally high levels of nitrogen and phosphorus, favors the development of aquatic vegetation. The quantities of nutrients from forested basins is very low. The effect of cultivated zones on the level of nutrients is evident at Briane. Certain sections of the Aveyron exhibit auto-epuration - a phenomenon associated with denitrification bacteria. The three locations with the greatest basin slopes (Severac, Laissac and Rodez) are the origin of most of the point source pollution. (Moore-IVI) W83-00092 W85-00092

DISTRIBUTION OF BACTERIAL PLASMIDS IN CLEAN AND POLLUTED SITES IN A SOUTH WALES RIVER, University Coll., Cardiff (Wales). Dept. of Applied

University Coll.,
Biology,
N. F. Burton, M. J. Day, and A. T. Bull.
Applied and Environmental Microbiology, Vol.
44, No. 5, p 1026-1029, November, 1982. 2 Tab, 18

Descriptors: *Bacteria, *Plasmids, *Wales, *River Ely, Sediments, Water pollution effects, DNA, Conjugal transfer.

ndred aerobic heterotrophic bacteria were isolated from the sediment of unpolluted and pol-luted sites in the River Ely, a fast-flowing south Wales river. Isolates were subjected to taxonomic tests and screened for the presence of plasmid DNA by alkaline lysis and agarose gel techniques. There were no significant differences between sites in either the total percentage of isolates containing plasmids (unpolluted site 9.4%; polluted site 15%) or in the percentage of non-Pseudomonas-like iso-lates containing plasmids (unpolluted site 15%; pol-luted site 10%). There were significantly more Pseudonomas-like isolates with plasmids at the polrecuonomas-nec isolates with passmas at the poi-luted site than at the unpolluted site (unpolluted site 7%; polluted site 18%). This presumably re-flected a response of the nutritionally versatile Pseudomonas-like isolates to conditions at that site. The majority (86%) of the plasmids detected had molecular masses between 35 and 312 megadaltons. molecular masses between 35 and 312 megadaltons. These plasmids were large enough to carry genes for conjugal transfer, suggesting the possibility of such transfer in this environment. One result of the technique used in this study supposedly is the reflection of a response to a generally increased level of pollutants. The values for plasmid occurrences reported are minimum values for two main reasons. First, the technique used will not detect plasmids which are integrated with the host chromosome (i.e. episomes). Second, the band of chro-mosomal DNA on the agarose gels may obscure plasmids of 25 to 35 Md. (Baker-IVI)

IMPACT OF COAL-COKING EFFLUENT ON SEDIMENT MICROBIAL COMMUNITIES: A MULTIVARIATE APPROACH,

e Univ., Knoxville. Dept. of Microbiolo-

gy. G. S. Sayler, T. W. Sherrill, R. E. Perkins, L. M. Mallory, and M. P. Shiaris. Applied and Environmental Microbiology, Vol. 44, No. 5, p 1118-1129, November, 1982. 6 Fig, 2 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Microbiological studies, *Industrial wastes, *Coking, Coal wastes, Alkaline phosphatase, Naphthalene, Phenanthrene, Mineralization, Nitrogen fixation, Protein, Anaerobic conditions, Methane.

The response of a natural microbial community to coal-coking wastewater contamination was de-scribed in order to predict microbial community responses to coal-conversion contaminant-induced ecosystem perturbations. A specific objective was to determine whether coal coking wastewater caused a permanent alteration in the microbial community's ability to respond to temporal changes in the environment and to evaluate that

response with respect to PAH biotransformation rates. Those microbial variables that provide the greatest information in detecting changes or responses within the microbial community of a contaminated environment were also sought. Findings support the hypothesis that multiple functional measures of microbial community response are required to evaluate the effect of and recovery from environmental contamination. When long term effects are evaluated, select physiological traits such as polyaromatic hydrocarbon mineralization may not reflect population and biomass estimates of community response. (Baker-IVI)

EFFECT OF EFFUENT FROM A NITROGEN FERTILIZER FACTORY AND A PULP MILL ON THE DISTRIBUTION AND ABUNDANCE AEROMONAS HYDROPHILA IN ALBE-

OF AEROMONAS HYDROPHILA IN ALBE-MARLE SOUND, NORTH CAROLINA, Puerto Rico Univ., Rio Piedras. Dept. of Biology. T. C. Hazen, and G. W. Esch. Applied and Environmental Microbiology, Vol. 45, No. 1, p 31-42, January, 1983. 7 Fig, 6 Tab, 35

Descriptors: *Water pollution effects, *Industrial wastes, *Aeromonas, *Albemarle Sound, *North Carolina, Pulp and paper industry, Kraft process, Fertilizers, Pulp wastes, Nutrients, Phosphates, Phytoplankton, Nitrates, Epizootics, Fish diseases, Roanoke River, Chowan River, Estuaries.

The densities of Aeromonas hydrophila in Albe-marle Sound were studied to determine if they were affected by the industrial waste effluents present in the area. Albermarle Sound is a natural estuary with a mean depth of 3 m, a maximum depth of 20 m and a shoreline length of 600 km. The total watershed covers 45,695 sq km. The two main tributaries are the Roanoke River and the Chowan River. A Kraft pulping process papermill is located on the Roanoke River, discharging 147 000 00 liters/day into Welch Creek, a small present in the area. Albermarle Sound is a natural is located on the Roanoke River, discharging 147,000,000 liters/day into Welch Creek, a small feeder that joins the Roanoke River. A nitrogen fertilizer factor near Winton, N.C., on the lower Chowan River released 544 kg of total nitrogen each day during this study into the Chowan River. The impact of the pulp mill on water quality was acute, whereas that of the nitrogen fertilizer factory was chronic and much more subtle. A hydronic rad much more subtle. A hydronic rad much more subtle. ry was chronic and much more subtle. A. hydroby was canonic and much more stools. A nyuro-phila survival is increased by pulp mill effluent and decreased by nitrogen fertilizer factory effluent. A. hydrophila was directly affected by phytoplankton density and, thus, indirectly by concentrations of observables, activate, are total preate, nitrate, and total organic carbon. The phosphate, mitrate, and total organic carbon. These two point sources are suspect as indirect causes of red-sore disease epizootics, a disease of fish caused by A. hydrophila. (Baker-IVI) W85-00096

UPSTREAM MIGRATION BY YOUNG PIGMENTED FRESHWATER EELS (ANGUILA AUSTRALIS AUSTRALIS RICHARDSON) IN

Tasmanian Inland Fisheries Commission, Hobart (Australia). For primary bibliographic entry see Field 6G. W85-00131

ANTIMONY AND THALLIUM TOXICITY TO EMBRYOS AND LARVAE OF FATHEAD MINNOWS (PIMEPHALES PROMELAS),

NOWS (PIMEPHALES PROMELAS), EG and G Bionomics, Warcham, MA. G. A. LeBlanc, and J. W. Dean. Bulletin of Euvironmental Contamination and Toxicology, Vol. 32, No. 5, p 565-569, April, 1984. 1 Tab, 16 Ref. EPA contract 78-01-4646.

Descriptors: *Water pollution effects, *Antimony, *Thallium, *Minnows, Adsorption, Fish, Larval growth stage, Hatching, Embryonic growth stage, Metals.

Fathead minnow embryos hatched normally wh exposed to antimony concentrations as high as 7.5 microg/L. Survival and growth of larvae was also unaffected from exposure to antimony concentrations at this level. Solutions saturated with antimony, as antimony trioxide, appear therefore not to be

toxic to fathead minnows. No fathead minnow toxic to fathead minnows. No fathead minnow embryos survived exposure to 720 microg/L thallium. Significantly fewer embryos exposed to 350 micro g/L successfully hatched than would be normally expected. Embryos were not affected by exposure to thallium concentrations as high as 200 microg/L. No fathead minnow larvae survived exposure to 350 microg/L thallium. Larvae survived awas significantly reduced from exposure to thallium concentrations as low as 40 microg/L. The Maximum Acceptable Toxicant Concentration for thallium, as thallium sulfate, is estimated to be less than 40 micro g/L. Thallium exhibited considerable chronic toxicity. (Baker-IVI) W85-00134

FISH MORTALITY FOLLOWING APPLICA-TION OF PHENTHOATE TO FLORIDA TION OF CITRUS,

Agricultural Research and Education Center, Lake Alfred, FL. H. N. Nigg, J. H. Stamper, R. M. Queen, and J. L.

Knapp.
Bulletin of Environmental Contamination Toxicology, Vol. 32, No. 5, p 587-596, April, 1984. 5 Tab. 1 Ref.

Descriptors: *Water pollution effects, *Fish, *Phenthoate, *Florida, *Citrus fruits, Gastropods, Insects, Toxicity, Mortality, Pesticides, Bass, Blue-

Florida citrus growers regularly apply pesticides near bodies of water and also may pump water from nearby lakes and ditches to supply spay machines. On April 27, 1982, 4 lb/gal emulsifiable phenthoate was applied to 33 acres of mature citrus trees at a rate of 10 lb phenthoate AI/A. Water trees at a rate of 10 lb phenthoate AI/A. Water was pumped into the supply vehicle from a pond and, as the vehicle was filling, pesticides were added to the tank. All precautions were taken to prevent pesticide from entering the pond. Bach sampling day the near shoreline regions of the control and treatment ponds were inspected for dead or dying aquatic organisms. None were observed in the control pond. Uncaged fish were still active postspray and demonstrated no observable problems. In the treatment pond no dead or dying organisms were noted 3 hr after application. On day 1 postapplication, dragonflies, cove-headed grasshoppers, angular winged katydid, and various species of snails were dead or dying on the surface of the pond. One dead bass and 30 bluegills were retrieved. On day 2 more dead fish were retrieved. During the next several days, additional dead fish During the next several days, additional dead fish appeared on the surface of the treatment pond. No appeared on the surface of the treatment pond. No live fish were observed in the treatment pond from day 2 to day 8, but 3 small live minnows were noted at the boat launch on day 8. Fish in treatment cages, when alive, appeared to be in shock and responded sluggishly when prodded. The western side of the treatment pond received more drift than the eastern half, consistent with westerly winds observed during application. (Baker-IVI) W85-00135 W85-00135

TOXICITY AND ACCUMULATION OF MER-CURY IN FISH, THE HIMEDAKA ORYZIAS

Tokyo Univ. of Fisheries (Japan). Y. Nagashima, T. Kikuchi, and M. Chiba. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No.1, p 95-99, January, 1984. 7 Fig.

Descriptors: *Mercury, *Bioaccumulation, *Oryzias, *Himedaka, *Toxicity, Methyl mercury, Mercuric chloride, Mortality, Heavy metals, Organomercury compounds, Water pollution effects.

The toxicity of mercury to Himedaka (Oryzias latipes) was assessed at exposures of 100-1000 ppb mercuric chloride and 50-300 ppb methyl mercuric chloride (MeHgCl) in water tanks using the still water method. LC50 values obtained were 700 ppb and 155 ppb for HgCl2 and MeHgCl, respectively. In live fish 25 ppm was the maximum concentration regardless of the concentration of HgCl2 used for respine. Concentrations in dead fish were very for rearing. Concentrations in dead fish were very high, ranging from 41-58 ppm when reared in 600-

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1000 ppb HgCl2 solutions. No conversion of HgCl2 to MeHgCl was noted. The percentage of organic mercury in total Hg in fish reared in MeHgCl solutions was fairly consistent, being 60-90%. No evidence was found for the conversion of 90%. No evidence was found for the conversion of methyl mercury to other forms of mercury in fish bodies. Accumulation of mercury in Himedaka was not observed in the group reared with the feed containing mainly HgCl2. Throughout the 5 week period the total Hg concentration remained less tha 0.1 ppm. In contrast, gradual accumulation was observed in the other group of fish reared with the feed containing mainly methyl mercury. The total Hg concentration reached 0.34 ppm after 5 weeks, 85-95% of which was methyl mercury. (Baker-IVI) IVI) W85-00138

SEASONAL CHANGE IN THERMAL TOLER-ANCE OF COMMON ESTUARINE CRUSTA-CEANS, Universidad de Oriente, Cumana (Venezuela). Inst.

Onversidad de Oriente, Cumana (Venezuela). Inst. Oceanografico. K. S. Chung, and K. Strawn. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 3, p 451-456, 1984. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Crustaceans, *Cooling towers, *Thermal pollution, *Survival, *Bacliff, *Texas, Galveston Bay, Water temperature, Seasonal variation, Estuarine environment, Intake canals, Canals,

The common estuarine crustaceans collected in the intake canal of the P. H. Robinson Generating Station, Bacliff, Texas, were tested for 180 minutes at various discharge canal temperatures during June 1974 through September 1975 to determine if they could survive passage through a discharge cooling system. Temperature ranged from 13.0 to 31.1 degrees C in the intake canal, from 14.4 to 42.2 in the discharge canal above the cooling towers, and from 22.3 to 37.8 below the cooling towers. Before June and after September efferent towers, and from 22.3 to 37.8 below the cooling towers. Before June and after September efferent temperatures were usually under 35 degrees C and the cooling towers were not operated. Three-hr LD50 temperatures were significantly higher, throughout the year, than the temperatures in the discharge canal downstream from the cooling towers, indicating that crustaceans should survive passage to Galveston Bay. The thermally critical period of the year for the crustaceans entrained and entrapped from intake water and exposed to hot discharge effluent is the summer, especially June-August, when discharge canal temperatures are nearly 40 degrees or greater. (Baker-IVI) W85-00140

SPAWNING SITE WATER CHEMISTRY AND LAKE TROUT (SALVELINUS NAMAYCUSH) SAC FRY SURVIVAL DURING SPRING

SAC FRY SURVIVAL DURING SPRING SNOWMELT, Ontario Ministry of Natural Resources, Toronto. J. M. Gunn, and W. Keller. Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 2, p 319-329, February, 1984. 6 Fig. 1 Tab, 43 Ref.

Descriptors: *Trout, *Snowmelt, *Aluminum, *Acidic water, *Fish fry, *Whitepine Lake, *Ontario, Acid precipitation, Mortality, Spawning, Hydrogen ion concentration, Water pollution effects.

Fluctuations of pH associated with snowmelt can occur in poorly buffered lakes receiving high acid loadings. For fall spawning fish, especially species that spawn near shorelines in shallow waters, the timing of hatch, yoke absorption, and emergence may subject progeny to depressed pH levels and elevated lithologically derived aluminum concentrations produced by snowmelt. Aluminum appears to cause fish mortalities under acidic conditions. During the spring of 1982, lake trout (Salvelinus namaycush) sac fry were incubated at a spawning bed in Whitpain Lake, 90 km north of Sudbury, Ontario, a pH 5.7 lake with a history of lake trout recruitment failure. Snow-pack pH ranged from 4.5 to 5.2 and rainfall pH ranged from 3.6 to 4.9. Four short episodes of substantial pH depression occurred at the spawning site. Observed sac fry

mortalities (18%) occurred primarily during the longest depression (5 d at pH 4.5-5.0), which coincided with maximum surface runoff and peaks in concentrations (approximately 50 micro g/L) of inorganic (monomeric) Al. Although most mortalities were coincident with low pH and elevated inorganic Al concentrations, the high survival (82%) demonstrated that under natural conditions most sac fry could tolerate pH < 5.0 and inorganic Al concentrations of 40-50 micro g/L for at least 5 d. Substantially higher concentrations of inorganic Al (approximately 80 micro g/L) were observed in the interstitial waters of the spawning rubble than in ambient waters, which indicated that fry within a spawning substrate may be subjected to more toxic conditions than test fry in incubators above the substrate surface. Conventional open-water sampling programs, and field and laboratory bioassays, may not adequately describe responses of natural populations to acidification. (Collier-IVI) W85-00150

EMPIRICAL PREDICTION OF CRUSTACEAN ZOOPLANKTON BIOMASS AND PROFUNDAL MACROBENTHOS BIOMASS IN LAKES, McGill Univ., Montreal (Quebec). Dept. of Biol-

For primary bibliographic entry see Field 2H. W85-00152

FATE OF KEPONE AND MIREX IN THE AQUATIC ENVIRONMENT, Columbia National Fisheries Research Lab., MO. For primary bibliographic entry see Field 5B. W85-00160

ACUTE TOXICITY, BIOCONCENTRATION, AND PERSISTENCE OF AC 222,708, BENTHIOCARB, CHLORPYRIFOS, FENVALERATE, METHYL PARATHION, AND PERMETHRIN IN THE ESTUARINE ENVIRONMENT, Environmental Research Lab., Gulf Breeze, FL. S. C. Schimmel, R. L. Garnas, J. M. Patrick, Jr., and J. C. Moore.

Journal of Agricultural and Food Chemistry, Vol. 31, No. 1, p 104-113, January-February, 1983. 3 Fig, 8 Tab, 52 Ref.

Descriptors: *Toxicity, *AC 222,705, *Benthiocarb, *Chlorpyrifos, *Fenvalerate, *Methyl parathion, *Permethrin, *Biological magnification, *Persistence, Pyrethroids, Oysters, Partition coefficient, Solubility, Crustaceans, Sheepshead minnows, Pesticide kinetics, Organophosphorus pesticides, Bioaccumulation

Six pesticides were evaluated in laboratory studies to determine acute (96-h) toxicity, octanol-water partition coefficient (log P), solubility, and persistence in seawater. In addition, three of the six pesticides (synthetic pyrethroids) were tested by using the eastern oyster (Crassostrea virginica) in long-term (28-day) tests to determine their respective bioconcentration factors (BCF). Acute toxicity tests provided the following decreasing order of toxicity to estuarine crustaceans and fishes: AC 222,705, fenvalearate, permethrin, chlorpyrifos, methyl parathion, and benthiocarb. The estuarine mysid (Mysidopsis bahia) was consistently the most sensitive species, with LC50 values as low as 0.008 micro g/L. The sheepshead minnow (Cyprinodon variegatus) was generally the least sensitive (range of LC50 values = 1.1-1370 micro g/L). log P values were inversely related to solubility in seawater. The following are the increasing order of tive (range of LCSO values = 1.1-1370 micro g/L). log P values were inversely related to solubility in seawater. The following are the increasing order of log P values (range 1.8-6.5) and decreasing order of solubility (range > 1000-24 micro g/L): methyl parathion, benthiocarb, chlorpyrifos, AC 222,705, fenvalerate, and permethrin. Pesticide half-lives in sediment-water studies range from 1.2 to 34 days and were in the following order of increasing persistence: methyl parathion, permethrin, benthiocarb, AC 222,705, chlorpyrifos, and fenvalerate. The steady-state BCF's of the three synthetic pyrethroids were 1900 for permethrin, 2300 for AC 222,705 and 4700 for fenvalerate. After termination of the exposure, each insecticide was depurated by of the exposure, each insecticide was depurated by oysters to nondectable concentrations within 1 eek. (Author's abstract)

ACEPHATE IN RAINBOW TROUT (SALMO GAIRDNER): ACUTE TOXICITY, UPTAKE, ELIMINATION,

Simon Fraser Univ., Burnaby (British Columbia).
Dept. of Biological Sciences.
G. H. Geen, B. A. McKeown, and P. C. Oloff.

Journal of Environmental Sciences and Health, Vol. Bl9, No. 2, p 131-155, June, 1984. 3 Fig, 4 Tab, 30 Ref.

Descriptors: *Acephate, *Trout, *Toxicity, *Elimination, *Bioaccumulation, Organophosphorus pesticides, Biological magnification, Methamidophos, Partition coefficient, Water pollution

The 96-h LC50 of acephate, a water-soluble organ-ophosphorus insecticide, averaged 2,740 ppm for rainbow trout. Such low acute toxicity is apparent-ly unique among commercial insecticides. Uptake of acephate by trout from water was rapid and reached equilibrium concentrations (4 to 6% of ambient concentrations) in 5 to 8 days. Methami-dophos, a metabolite of acephate, formed rapidly, reaching approximately 25% of the acephate con-centrations in the fish. Elimination of 50% of ace-phate and methamidonhos from rainbow trout re-peated and methamidonhos from rainbow trout recentrations in the fish. Elimination of 50% of ace-phate and methamidophos from rainbow trout re-quired 1.73 to 2.43 days. Neither acephate nor methamidophos were bioconcentrated in the trout (mean biconcentration factor = 0.0533). Predic-tions of bioconcentration of acephate, based on its water solubility, its octanol/water partition coeffi-cient, or based on relationships developed in other studies, did not, as a rule, agree with the experi-mental results. (Author's abstract) W85-00169

EFFECTS OF ACEPHATE (ORTHENE) ON DE-VELOPMENT AND SURVIVAL OF THE SALA-MANDER, AMBYSTOMA GRACILE (BAIRD), Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.

G. H. Green, B. A. McKeown, T. A. Watson, and

Journal of Environmental Sciences and Health, Vol. B19, No. 2, p 157-170, June, 1984. 2 Fig, 16

Descriptors: *Acephate, *Orthene, *Salamanders, Toxicity, Organophosphorus pesticides, Water pol-lution effects, Hatching, Eggs, Larval growth stage, Mortality, Growth rates.

The effects of acephate, a water-soluble organophosphorus insecticide, on the early growth and survival of the salamander, Ambystoma gracile, were examined. The 96-h LC50 for 69-day old were examined. The 96-h LC50 for 69-day old larvae was 8816 mg/L. Exposure of egg masses to concentrations up to 798 mg/L did not produce significant differences in mortality up to the time of hatching. Larval mortality in the first 7 days after hatching increased at the higher acephate concentrations but declined in the period day 7-29 to low rates independent of acephate concentration. Growth rate decreased and morphological abnormalities increased in larvae exposed to 382 and 798 mg/L acephate. This component of lake fauna would be little affected by insect control layer of the programs which use acephate since maximum surprograms which use acephate since maximum sur-face water concentrations would probably be < 1 mg/L. (Author's abstract) W85-00170

IN VITRO EFFECTS OF ACEPHATE ON ACE-TYLCHOLINESTERASE ACTIVITY IN THE BRAIN AND GILLS OF RAINBOW TROUT, SALMO GAIRDNERI,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences. T. A. Watson, P. A. G. Tilley, B. A. McKeown,

and G. H. Geen. Journal of Environmental Sciences and Health, Vol. B19, No. 2, p 171-181, June, 1984. 1 Fig. 1 Tab, 20 Ref.

Descriptors: *Acetylcholinesterase, *Brains, *Gills, *Trout, *Acephate, Toxicity, Organophos-phorus pesticides, Water pollution effects, Orth-ene, Esterase activity.

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The in vitro effects of acephate (Orthene), a water-soluble organophosphorus (OP) insecticide, on acetylcholinesterase (AChE) activity in rainbow trout tissues were investigated over an acephate concentration range of 1,000 mg/L (3.5 mM) to 25,000 mg/L (136 mM). A recognized toxic action of OP insecticides is the direct inhibition of AChE with the coresponent burgerstimulatory neurotransof OP insecticides is the direct inhibition of AChE
with the consequent hyperstimulatory neurotransmitting action of acetylcholine. Measurements of in
vitro AChE activity were based on the difference
between total esterase activity and esterase activity
in the presence of .0001 M eserine. A decline of
AChE activity to < 18% of control activity, a
level previously reported to be associated with fish
mortality, was reached at concentrations of 25,000 mortally, was recursed as concentrations required to produce 50% inhibition of AChE in the brain and gill were 12,600 mg/L and 14,100 mg/L respectively. Since such concentrations would not occur in natural waters following use of acephate to control terres-trial insect pest populations, fish mortalities would not be expected. (Collier-IVI) W85-00171

INFLUENCE OF EXPERIMENTAL SEWAGE POLLUTION ON LAGOON PHYTOPLANK-TON,

Institute of Geological Sciences, Nottingham (England). Geochemistry and Petrology Div. N. Fanuko.

Marine Pollution Bulletin, Vol. 15, No. 5, p 195-198, 1984. 5 Fig. 12 Ref.

Descriptors: *Phytoplankton, *Population dynamics, *Water pollution effects, *Wastewater pollution, *Lagoons, Coastal areas, Chlorophyll a, Biomass, Seasonal variation.

Phytoplankton populations were examined in two experimental basins during an in situ enrichment program in coastal lagooms at Stunjan, north Adriatic, from 1976 to 1978. Within a large lagoon two experimental basins were constructed, 63 sq m each, one of them receiving 300 1 of primary settled municipal sewage and the other one serving as the control. In the clean lagoon the phytoplankton exhibited regular seasonal variations. During the warm part of the year the lagoon was rich in phytoplankton. The phytoplankton growth in the polluted lagoon, however, showed marked symptoms of inhibition. Chlorophyll a values were significantly lower too. There was no correlation at all between chlorophyll a and cells in the polluted lagoon, while in the clean one a significant relationship between the two variables was found. (Baker-IVI) Phytoplankton populations were examined in two

MERCURY LEVELS IN BROOK TROUT (SAL-VELINUS FONTINALIS) FROM SELECTED ACID AND LIMED ADIRONDACK LAKES,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Natural Resources.
R. Sloan, and C. L. Schofield. Northeastern Environmental Science, Vol. 2, No. 3/4, p 165-170, 1983. 1 Fig. 3 Tab, 22 Ref.

Descriptors: *Trout, *Mercury, *Adirondack Mountains, *New York, *Liming, Acid lakes, Acidity, Heavy metals, Water pollution effects, n ion concentration

Liming of acidified lakes is effective in maintaining pH levels conducive to fish survival and has been extensively employed in acid lakes of the Adiron-dack Mountains of New York. Concern that liming might increase mercury body burdens in fish led to magni mclease nearcuty body outdens in that net to the sampling and analysis by atomic absorption spectrophotometric methods of whole brook trout (Salvelinus fontinais) from 15 small lakes. Brook trout inhabiting acid drainage lakes with pH 5 exhibited significantly higher mercury concentra-tions than more alkaline acid drainage, seepage and loce, tune lakes. The secretary of the contractions than more alkaline acid drainage, seepage and bog type lakes. There was no evidence of in-creased mercury uptake by brook trout due to liming practices utilized in Adirondack lakes. None of the brook trout or other species sampled from the Adirondack lakes in this study had mercury concentrations greater than the Food and Drug

dministration action level of 1.0 ppm. (Baker-IVI) W85-00204

IN-SITU BIOASSAYS OF FISH MORTALITY IN TWO PENNSYLVANIA STREAMS ACIDI-FIED BY ATMOSPHERIC DEPOSITION, Pennsylvania State Univ., University Park. School of Forest Resources.

W. E. Sharpe, W. G. Kimmel, E. S. Young, Jr., and D. R. DeWalle.

Northeastern Environmental Science, Vol. 2, No. 3/2, p 171-178, 1983. 4 Fig. 3 Tab, 22 Ref.

Descriptors: "Fish, "Mortality, "Acid streams, "Pennsylvania, "Bioassay, Water quality, Acid rain, Water pollution effects, Atmospheric deposi-tion, Hydrogen ion concentration, Aluminum, Toxicity, Trout, Sculpin.

A limited in-situ bioassay of fish mortality for the species Salvelinus fontinalis, Salmo gairdneri, Salmo trutta and Cottus bairdi was conducted on Salmo trutta and Cottus bairdi was conducted on two streams, Wildcat and McCinnis Runs, during February and March 1982. Both streams are suffering from varying degrees of acidification attributed to atmospheric deposition. These streams are located on adjacent watersheds on the Laurel Hill in southwestern Pennsylvania. Bioassay tanks were set up along each stream and maintained by a gravity flow of stream water. The less acidified stream, Wildcat Run, served as control. Observations of water guality during the experiment restream, windcar full, served as control. Conserva-tions of water quality during the experiment re-vealed severe depressions of pH and increases of total aluminum in the water of McGinnis Run and similar but much less severe changes on Wildcat Run. Trout mortality in McGinnis Run com-menced during the first 24 hr of exposure. By the end of 9 days, all wild and hatchery-reared trout had succumbed with the exception of wild brook trout. Nearly all fish and invertebrates in the Wild-cat Run tank survived beyond the study period and showed no signs of stress. The mottled sculpin was the most tolerant of all fish tested. Allonarcys the most tolerant of all fish tested. Allonarcys proteus was the most tolerant organism, although this organism is not found in McGinnis Run. Microscopic examination of the gill filaments of the dead fish revealed the presence of a yellowish deposit characeristic of aluminum toxicity. Fish stress symptoms at the time of death and species tolerance differences were also typical of low pH-high aluminum toxicity. The lack of more detailed aluminum analysis obviates the conclusion that aluminum was a factor in the deaths of the McGinnis Run fish. (Baker-IVI)

ACID RAIN: NEW SO2 CONTROLS INEVITA-

BLE, L. Catalano, and J. Makansi. Power, Vol. 127, No. 9, p 25-33, September, 1983. 2 Fig, 1 Tab.

Descriptors: "Acid rain, "Legislation, "Sulfur di-oxide, "Water pollution control, Powerplants, Util-tics, Scrubbers, Waste treatment, Air pollution control, Acid lakes.

Acid dead lakes are believed to result from the poor buffering qualities of the surrounding soils, rather than from rain falling directly into the lakes. Lakes are not the only victims. Damage to vegetation is extreme in some areas. Environmentalists urge that the only way to stop this ecological damage is to reduce emissions at the powerplants. Utilities vehemently protest this presentation of the problem urging that more conclusive evidence be gathered, perhaps through the use of radioactive tracer elements placed in the emissions of midwestproblem urging that more conclusive evidence be gathered, perhaps through the use of radioactive tracer elements placed in the emissions of midwestern powerplants and the path of the gases followed. The differences of opinion voiced by the environmentalists vs the utilities makes coming to a decision on this issue very difficult. The various legislative proposals that Congress has to choose from are outlined. Fueling the debate over the various proposals is an inundation of reports from scientific research organizations. Options open to industry to meet the acid-rain emission limits include wet lime/limestone flue-gas desulfurization coal cleaning, low-sulfur coal switch, spray-dryer

FGD, atmospheric fluidized-bed combustion, lime-stone-injection multistage combustion, and post-injection dry-sorbent injection. (Baker-IVI) W85-00210

ANALYSIS OF CILIATA FROM POLLUTED SECTOR OF THE RIVER DRWINKA ON THE BASIS OF BINARY DATA,

Jagiellonian Univ., Krakow (Poland). Dept. of Hydrobiology. For primary bibliographic entry see Field 2. W85-00223

OCCURRENCE OF WATER MITES (HYDRA-CARINA) IN THE RIVER WIEPRZ POLLUTED WITH DOMESTIC-INDUSTRY SEWAGE,

Akademia Rolnicza, Lublin (Poland). Dept. of Zo-ology and Hydrobiology. W. Kowalik, and E. Biesiadka.

Acta Hydrobiologica, Vol. 23, No. 4, p 331-348, 1981. 3 Fig, 5 Tab, 20 Ref.

Descriptors: *Mites, *Rivers, *Water pollution effects, *River Wieprz, *Poland, Bioindicators, Industrial waste, Municipal waste.

The occurrence of Hydracarina was investigated in the River Wieprz, which is polluted with domestic-industry sewage. A total of 42 species of water mites was found. Species structure showed great similarity with Polish lowland rivers. Three great similarity with Polish lowland rivers. Three main groups of species were distinguished. The most interesting group was connected mainly with mountain and submontane running waters and included Lebertia pilosa, L. slovenica, Torrenticola stadleri, Hygrabates longiporus, Satractides tener, and Mideopais roztoczensis. The second group was the most numerous and was constituted by largely spread water mites including Hygrobates fluviatilis along with Sperchon setiger, Lebertia inacqualis, Hygrobates calliger, and Sperchon clupeifer. The third, fairly large group consisted of species connected with stagmant waters. There was an evident, negative correlation between the abundance of water mites and the number of their species and the degree of water pollution. The possibility of water mites and the humber of their species and the degree of water pollution. The possibility of using water mites as indicators of the level of water pollution was estimated. (Baker-IVI) W85-00224

EFFECT OF WASTE WATER ON CILIATE COMMUNITIES IN THE BIALA PRZEMSZA

Jagiellonian Univ., Krakow (Poland). Inst. of Environmental Biology. For primary bibliographic entry see Field 2H.

W85-00227

GROUPS OF PELAGIC ZOOPLANKTON IN THREE LAKES OF DIFFERENT TROPHY, Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 2H.
W85-00228

ZONATION OF MAYFLIES (EPHEMEROP-TERA) IN SEVERAL STREAMS OF THE TATRA MTS AND THE PODHALE REGION, Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych. For primary bibliographic entry see Field 2H. W85-00229

EFFECT OF RAIN WATERS ON LEAD LEVEL IN THE VISTULA IN THE REGION OF CRACOW AGGLOMERATION,

Instytut Ksztaltowania Srodowiska, Krakow (Poland). I. Skoczen

Acta Hydrobiologica, Vol. 24, No. 2, p 95-107, 1982. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Lead, *Water quality, *Storm runoff, *Krakow, *Vistula, *Poland, Snowmelt,

Effects Of Pollution-Group 5C

Urban runoff, Public health, Drinking water, Diur-

The quantity and duration of polluted runoff was investigated in the Vistula in the region of Cracow. Day and night variations of lead level were established under various hydrological and meteorological conditions. The problem was to investigate the dynamics of pollutant variations of the Vistula in cal conditions. The protein was to investigate the dynamics of pollutant variations of the Vistula in dependence on the character, intensity, and location of atmospheric precipitations. The starting point of the study was protection of the water taken in for drinking purposes and necessity of estimating the sanitary state of the catchment area of the Upper Vistula. The lowest amount of lead variability was found during the dry period. During the precipitation and thaw periods the day and night variability was considerably higher and depended on the amount of runoff pollution and location of atmospheric precipitation. The quantity of lead loads during precipitation periods was conditioned by the character and location of atmospheric precipitation. Greatest lead loads occurred during periods of continuous precipitation. In some cases, maximum lead concentrations exceeded the level for the third class of surface water purity in Poland. Storing water for drinking purposes pro-Poland. Storing water for drinking purposes pro-ceeded mainly during periods of high flow. (Baker-IVI) W85-00230

EFFECT OF RAIN WATERS ON SALINITY VARIATION OF THE VISTULA IN THE REGION OF CRACOW AGGLOMERATION (ON THE EXAMPLE OF CHLORIDES),

Ksztaltowania Srodowiska, I Skoc

Acta Hydrobiologica, Vol. 24, No. 2, p 109-124, 1982. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Salinity, *Storm runoff, *Vistula, *Krakow, *Poland, *Rain, *Chlorides, Water quality control, Diurnal variation, Snowmelt.

Chlorides are the main components of salinity of the Vistula in the region of Cracow agglomeration. Chlorides do not undergo sedimentation for self-purification processes, thus eliminating the impact of water stages on the decrease in concentration values. A quantitative determination was made of the chlorides in the runoff and their influence on the Vistula in this region. Secondly, day and night the chlorides in the runoff and their influence on the Vistula in this region. Secondly, day and night investigations of the Vistula were made to determine the variation in salinity of the Vistula during diurnal periods and to examine the pollutant load in the river. Lowest chloride loads were found in the dry period in all the years investigated. In periods of precipitation and thawing the loads were higher. Highest loads were found during continuous precipitation localized in the region and above the Kracow agglomeration. Increases in salinity of the Vistula were dependent on the amount of atmospheric precipitation occurring to a greater linity of the Vistula were dependent on the amount of atmospheric precipitation occurring to a greater extent than on other factors. The diurnal variation of chloride loads was dependent to a great extent on meteorological factors. Lowest load values and lowest variability were found in the dry period. (Baker-IV) W85-00231

COMPOSITION AND ZONATION OF BENTHIC INVERTEBRATE COMMUNITIES IN SOME CHEMICALLY STRESSED AQUAT-IC HABITATS OF NIEPOLOMICE FOREST

IC HABITATS OF NIEPOLOMICE POREST (SOUTH POLAND), Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych. E. Dratnal, and E. Dumnicka. Acta Hydrobiologica, Vol. 24, No. 2, p 151-165, 1982. 6 Fig. 3 Tab, 11 Ref.

Descriptors: *Invertebrates, *Water pollution effects, *Forest watersheds, *Niepolomice Forest, *Poland, Acid waters, Dissolved oxygen, Organic matter, Oligochaetes, Chironomids, Benthos.

Four types of the invertebrate communities are distinguished in which Oligochaeta and Chirono-midae are dominant groups. The changes of some chemical factors along the water course under

study are presented along with their influences on the benthic macroinvertebrate community population. High acidity of the water causes a reduction in the number of taxons found at chemically stressed sites. The Niepolomice Forest area, the study site, is divided by the Drwinka River into a southern and a northern part. In the northern part a decidous forest predominates, while the southern part is mixed. Thirteen study sites were chosen, 4 along the middle stretch of the Drwinka River, 5 along the Traczowka Stream in the southern part of the forest, 2 sites in the lode in the southern part of the forest, tributary of the Traczowka Stream, and two sites in the lode in the northern part of the forest area. Very characteristic changes in acidity and two sites in the lode in the northern part of the forest area. Very characteristic changes in acidity were noted along the stream. The lowest value, below 5, occurred in the southern lode and pH below 6 was ascertained in the middle stretch of the Traczowka Stream. Among acidifying compounds chlorides and sulfates were abundant in the waters in the forest area. Changes in the carbon dioxide content, accompanied by the changes in the content of calcium and magnesium seem to influence pH. The levels of CO2 and of pH value are almost inversely proportional at all sites. annuence pri. Ine levels of CO2 and or pri value are almost inversely proportional at all sites, and only the ability of calcium and magnesium to buffer bicarbonates modifies this proportion. The content of the oxygen dissolved in the water at all sites was quite sufficient. COD and oxidizability levels reveal that the forest waters are rich in organic matter, consisting mainly of humus compounds resistant to bacterial decomposition. (Baker-IVI) W85-00233

RECENT TROPHIC CHANGES IN KOOTENAY LAKE, BRITISH COLUMBIA, AS RECORDED BY FOSSIL DIATOMS,

Department of Fisheries and Oceans, Vancouver (British Columbia). Field Services Branch. For primary bibliographic entry see Field 2H. W85-00249

SIMULATING THE BIOLOGICAL EFFECTS OF TOXICANTS IN AQUATIC MICROCOSM

Washington Univ., Seattle. School of Fisheries. G. Swartzman, and K. A. Rose. Ecological Modelling, Vol. 22, No. 104, p 123-134, 1983/1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Microcosms, *Water pollution effects, *Model studies, *Simulation, Bioassay, Toxicity, Aquatic environment, Mathematical equations, Phytoplankton, Zooplankton, Nitrogen, Phosphorus, Mesocosms

A multistage experimental approach involving lab-oratory bioassays, microcosms and mesocosms is proposed for assessing the effect of toxicant load-ing to an aquatic system. Simulation models can tie these experiments together and predict the response of natural ecosystems. The model simulator allows comparison of alternative equations from a number of models. The model structure includes 8 allows comparison of alternative equations from a number of models. The model structure includes 8 functional groups of phytoplankton, 5 groups of cooplankton, and nitrogen and phosphorus. The model consists of a system of non-linear differential equations representing, for each functional group, the rates of change of plankton biomass. Nutrient flows for phosphorus and nitrogen are also represented in the model. For equation calibration, a series of experiments was chosen offering substantially different environmental conditions with essentially the same biota, thereby allowing exposure of the model to a variety of conditions. The equations comparison is facilitated through a simulator called AEGIS (Aquatic Ecosystem General Impact Simulator) which allows selection of compatible groups of process equations in all possible combinations. Once the phytoplankton-zooplankton model is calibrated to the control microcosms, the next step is the linking of the effects of a toxicant to the biological processes in the model. For both phytoplankton and zooplankton, the toxicant effects must be related to the concentration of toxicant to which the organisms are exposed over time. (Moore-IVI)

EFFECT OF CUPRIC CHLORIDE ON OXIDA-TIVE METABOLISM IN THE FRESHWATER TELEOST, TILAPIA MOSSAMBICA.

Sri Venkateswara Univ., Tirupati (India). Pesticide and Industrial Toxicology Centre. M. Balavenkatasubbaiah, A. Usha Rani, K. Geethanjali, K. R. Purushotham, and R.

Ramamurthi. Ecotoxicology and Environmental Safety, Vol. 8, No. 3, p 289-293, June, 1984. 3 Tab, 11 Ref.

Descriptors: *Cupric chloride, *Tilapia, *Metabolism, *Toxicity, *Copper, Enzymes, Fish behavior, Stress, Oxidative metabolism, Succinate dehydrogenase, Lactate dehydrogenase,

The freshwater teleost Tilapia mossambica was subjected to lethal (6.0 mg/l = LC50/48 hr) and sublethal (1.5 mg/l copper treatment for 1, 7, and 14 days. The behavioral responses of fish exposed to lethal concentrations of CuCl2 include slight to lethal concentrations of CIUCL2 include slight exitation, irregular body movements, and increase in gill opercular movements. The unit metabolism of fish exposed to lethal and sublethal concentrations showed a significant (P < 0.001) decrease over the control animals. The stressed fish appear over the control animals. The stressed fish appear to be meeting the energy requirements through anaerobic oxidation, as indicated by elevated lactate dehydrogenase and decelerated succinate dehydrogenase activities that can be interpreted as a functional/physiological adaptation during copper intoxication and that these enzymes can be used as good indicators of the metal-induced stress. (Moore-IVI) W85,00271

BIOCHEMICAL AND HEMATOLOGICAL STUDIES ON PERCH, PERCA FLUVIATILIS, FROM THE CADMIUM-CONTAMINATED RIVER EMAN,

Goeteborg Univ. (Sweden). Dept. of Zoophysio-

logy. M.-L. Sjobeck, C. Haux, A. Larsson, and G. Lithner.

Ecotoxicology and Environmental Safety, Vol. 8, No. 3, p 303-312, June, 1984. 1 Fig. 3 Tab, 46 Ref.

Descriptors: *Perch, *Cadmium, *Eman, *Sweden, Water pollution effects, Toxicity, Industrial wastes, Blood, Fish, Immune response, Metab-

Since the beginning of the century, the lower reach of the Eman river system (Sweden) has been polluted by a discharge of cadmium and nickel from an accumulator factory at Fliseryd. The discharge of metals ceased when the factory was closed down in 1976, but there are still elevated cadmium levels in sediments and water down-stream from Fliseryd. In a field investigation, biochemical and hematological parameters were measured in perch. Perca fluviailis, living in the cadmium-contaminated river Eman. The number of lymphocytes was 45-100% higher in perch from of lymphocytes was 45-100% nighter in perch from the contaminated area than in the reference perch, indicating a stimulated immune defense. In addition, the cadmium-loaded fish suffered from a slight anemia and a disturbed carbohydrate metabslight anemia and a disturbed carbohydrate metabolism and blood plasma ion composition. The perch in Eman did not show any hyperglycemia or hypocalcemia, which are typical symptoms in cadmium-poisoned fish in laboratory experiments. The observed effects suggest that cadmium affects fish in the environment in a way similar to what has been observed in laboratory studies. The weaker response may imply that the perch in the field situation have adapted and thus acquired an increased resistance to cadmium. Biochemical and hematological methods have promise as diagnostic tools to reveal sublethal toxic responses in natural populations of fish. (Moore-IVI) ations of fish. (Moore-IVI) populations W85-00272

OIL SHALE - POTENTIAL ENVIRONMENTAL IMPACTS AND CONTROL TECHNOLOGIES, Environmental Protection Agency, Cincinnati,

E. R. Bates, W. W. Liberick, and J. Burckle. Environmental Progress, Vol. 3, No. 2, p 107-115, May, 1984. 4 Fig. 13 Tab, 6 Ref.

Group 5C-Effects Of Pollution

Descriptors: *Oil shale, *Water pollution control, *Environmental effects. Sulfur dioxide. *Environmental effects, Sul Wastewater treatment, Retort water

A program was begun in 1973 to evaluate potential A program was begun in 1973 to evaluate potential environmental impacts from oil-shale development activities and suggest various potential control technologies. Recent results of these activities are reported including field test results on control of sulfur gases at Occidental Oil Shale's Logan Wash Site, and Geokinetic's Kamp Kerogen Site, wastewater treatability studies on retort water and gas condensate at Logan Wash, and results of laboratory and field testing on raw and retorted oil laberatory and field testing on raw and retorted oil ahales. Of the various systems studied, the Strefford, EIC, MDEA, (Selectamine and Adip), Benfield, Diamox, and Selexol appear to have the potential for the greatest sulfur dioxide selectivity for application to direct fired retorts. Based on a cost evaluation of a model case, the Stretford cost evaluation of a model case, the Stretford process appears to be the most cost effective ap-proach for direct fired retorts. (Baker-IVI) W85-00285

NICKEL TOXICITY TO MICROBES: EFFECT OF PH AND IMPLICATIONS FOR ACID RAIN, New York Univ., NY. Lab. of Microbial Ecology. H. Babich, and G. Stotzky. Environmental Research, Vol. 29, p 335-350, De-cember, 1982. 7 Fig. 4 Tab, 39 Ref. EPA grant PSPR3179

Descriptors: *Nickel, *Hydrogen ion concentra-tion, *Acid rain, *Toxicity, *Microorganisms, Bac-teria, Actinomycetes, Yeasts, Fungi, Heavy metals.

A broad spectrum of microorganisms, including A ordar spectrum or introorgalisms, including cubacteria (nonmarine and marine), actinomycetes, yeasts, and filamentous fungi, were evaluated for their sensitivities to nickel. Wide extremes in sensitivity of Ni were noted among the filamentous fungi, whereas the range of tolerance to Ni of the yeasts, eubacteria, and actinomycetes was narrowyeass, eutociteria, and actionifycetes was hartow-er. With all microorganisms, the toxicity of Ni was potentiated as the pH was decreased to acidic levels. The mechanism(s) of how pH affects the toxicity of Ni has not been defined, although the formation of hydroxylated Ni species with differ-ing toxicities was not involved. The enhanced toxing toxicities was not involved. The ennanced vi-city of Ni at acidic levels may have implications for the toxicity of Ni in environments stressed by acid precipitation. (Author's abstract) W85-00286

EFFECTS OF COPPER ON SPECIES COMPOSITION OF PERIPHYTON IN A SIERRA NEVADA, CALIFORNIA, STREAM,

Freshwater Biological Association, (England). River Lab.
H. V. Leland, and J. L. Carter.
Freshwater Biology, Vol. 14, No. 3, p 281-296, June, 1984. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Copper, *Periphyton, *Water pollu-tion effects, *Convict Creek, *California, *Algae, Sierra Nevada, Chlorophyta, Chrysophyta, Cyano-phyta, Stream biota, Species diversity, Distons, Species composition, Abundance, Standing crop.

Changes in species composition of the periphyton of an oligotrophic, Sierra Nevada stream (Convict Creek, California) continuously dosed for 1 year at three concentrations of copper (2.5, 5 and 10 micro g/l total Cu; approximately 12, 25 and 50 ng/l Cu(2+)) were determined. The numerically most abundant taxa were Bacillariophyceae (Achnanthes minutiasima, Cooconeis placentula, Cymbella microcephala, C. sinusta, Fragilaria construens, F. crotoneasis, Navicula spp., Synedra caus and S. rumpens), and the Cyanophyta Lyngbya spp., a co-dominant during spring and summer. Population densities of Lyngbya spp. were markelly reduced at all test concentrations of copper. Population densities of the principal Chiorophyta (Spirogyra spp. and Cladophora spp.) and the diatom Amphipleura pellucida were reduced at 5 micro g/l total Cu. Of the twenty-two most abundant taxa, sixteen were reduced in abundance by dant taxa, sixteen were reduced in abundance by continuous exposure to 10 micro g/l total Cu. There was no commensurate reduction in standing

crop (total number of individuals of all taxa). Achnanthes minutissima, a co-dominant in the control was the primary replacement species. Other taxa that were more abundant at 5 micro g/l total Cu than in the control were Ceratoneis arcus, Coccancis placentula, Navicula spp. and Synedra rumpens. Only A. minutissima and Calothrix spp. were more abundant at 10 micro g/l than in the control. Three resemblance measures (Canberra metric, Bray-Curtis and Dice) and diversity (Brillouin's) were evaluated for detecting differences in species composition among experimental stream sections. The Canberra metric, an index sensitive to proportional rather than absolute differences, was the most informative of these indices. (Author's abstract) w85-00294 W85-00294

DISTRIBUTIONAL PATTERNS AND HABITAT CHARACTERISTICS OF AMPHIPODA (CRUS-TACEA) IN THE INLAND WATERS OF ISRAEL AND SINAI,

Hebrew Univ., Herusalem (Israel). Dept. of Zoolo-

For primary bibliographic entry see Field 2H. W85-00395

POPULATION GROWTH PATTERNS OF SKE-LETONEMA COSTATUM AND NUTRIENT LEVELS IN THE LOWER EAST RIVER, NEW

YORK, U.S.A., Geological Survey, Reston, VA. W. B. Samuels, G. S. Kleppel, and J. J. A. McLaughlin. Hydrobiologia, Vol. 98, No. 1, p 35-43, January, 1983. 8 Fig, 38 Ref. EPA grant R803370030.

Descriptors: *Skelotonema, *Diatoms, *East River, *New York, *Growth rates, Water pollu-tion effects, Phytoplankton, Nitrates, Phosphates, Silica, Seasonal variation, Nutrient requirements, Phytotoxicity.

Discharges to the lower Hudson River estuarine system (New York), which includes the East River, contribute nutrients, toxic substances, and suspended material which all may have variable effects on phytoplankton growth. The population growth patterns of the centric diston Skeletonema costatum and nutrient levels in the lower East River were examined through field measurements and laboratory experimentation. Maximum growth rates of this diatom (approximately 1.8 divisions and laboratory experimentation. Maximum growth rates of this diatom (approximately 1.8 divisions per day) were obtained in water samples from the late winter - early spring months. Summer water samples supported little or no growth of this diatom. Measurements of NH3-N, PO4-P, and Si in water samples from the lower East River indicated that nutrient saturated conditions exist year round in this area. During the summer months when S. costatum standing crop was low, the organism also failed to grow well in summer water samples incubated under controlled and near optimum conditions; grazing pressure is thus not limiting the population size during this period. Toxic substances in the water column may be responsible for limiting S. costatum growth during the summer months. During the summer low river flow period, the residence time of phytoplankton is longer than during the high flows experienced during the late winter and early spring; summer phytoplankton. winter and early spring; summer phytoplankton populations would be exposed for a longer period to local toxic conditions than would late winter -early spring populations. (Collier-IVI) W85-00397

WATER QUALITY AND THE ROTIFER POPU-LATIONS IN THE ATCHAFALAYA RIVER BASIN, LOUISIANA,

na Cooperative Wildlife Research Unit,

Louissana Cooperative Wildlife Research Unit, Baton Rouge. L. E. Holland, C. F. Bryan, and J. P. Newman, Jr. Hydrobiologia, Vol. 98, No. 1, p 55-69, January, 1983. 4 Fig. 4 Tab, 29 Ref. Army Corps of Engi-neers contract 14-16-0008-767.

Descriptors: *Rotifers, *Atchafalaya River, *Louisiana, *Water quality, Aquatic habitats, Plankton, Cluster analysis, Swamps, Species diversity, Susended solids, Dissolved solids, Organic carbon.

The Atchafalaya Basin contains North America's largest hardwood river-swamp. The basin, a rich and dynamic system, covers 4,662 sq km in south-central Louisiana. Distributional and ecological in-formation on the class Rotifera were compiled central Louistana. Distributional and ecological information on the class Rotifera were compiled from both flood controlled and uncontrolled reaches of the Atchafalaya River Basin. In this study, the lower basin is that portion of the Atchafalaya system south of Interstate Highway 10. The upper basin refers to the habitats of Petite Prairie Bayou near Melville. This upper area is virtually confined by levees. In the minimally altered lower basin a variety of aquatic habitats within a small area resulted in a very diverse rotifer community consisting of an average of 46 taxa. In contrast, only an average of 28 different taxa were collected in leveed upper basin habitats. Cluster analysis identified rotifer communities associated with areas of similar water quality. Variations in suspended solids, total dissolved solids, and organic carbon were most often significantly associated with variations in rotifer numbers from the lower basin. Seasonal flushing of backwater areas by mainstream waters is very important in maintaining the diversity of these lower basin rotifer communities. (Moore-IV)

TOXIC ASPECTS OF COPPER ON THE BIOMASS AND PRODUCTIVITY OF PHYTO-PLANKTON OF THE SAGUENAY RIVER, QUEBEC (ASPECTS TOXIQUES DU CUIVRE SUR LA BIOMASSE ET LA PRODUCTIVITE DU PHYTOPLANCTON DE LA RIVIERE DU SAGUENAY, QUEBEC),

Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.

R. Cote.

Hydrobiologia, Vol. 98, No. 1, p 85-95, January, 1983. 2 Fig, 3 Tab, 49 Ref.

Descriptors: *Saguenay River, *Quebec, *Copper, *Phytoplankton, *Biomass, *Productivity, Water pollution effects, Chlorophyll, Chlorella, Diatoms, Heavy metals.

The effect of copper ion (at 10, 50, 100, 200 and 400 micro g Cu/L) in vitro on chlorophyll concentrations and rates of primary productivity were studied in phytoplankton for 124 hours. The same copper concentrations were tested on Chlorella vulgaris for 8 days. These algal assays were carried out using the surface water of the Saguenay River. In natural populations of phytoplankton, photosynthesis was more sensitive than growth: at the lowest concentrations, such as 10 micro g Cu/L, copper seemed to increase the chlorophyll concentrations whereas the rates of primary production show a decrease of 60% with respect to the control. At higher concentrations of copper, the effect on chlorophyll concentrations is weak but the trol. At higher concentrations of copper, the effect on chlorophyll concentrations is weak but the effect on the rates of primary production is more pronounced (decrease of 86% to 90%). The penate diatoms are dominant (in all the samples) and these organisms are relatively resistant to copper. In Chlorella vulgaris, it was observed that with 100 micro g Cu/L, chlorophyll concentrations and rates of photosynthesis respectively decrease by 63% and 99% with respect to the control. At higher concentrations of copper, a maximum decrease of 70% and 99% respectively for chlorohigher concentrations of copper, a maximum de-crease of 70% and 99% respectively for chloro-phyll concentrations and rates of primary produc-tion are observed. Such selection for resistant taxa in populations of phytoplankton in the Saguenay River may have important implications in the low productivity in Saguenay Fjord. (Collier-IVI) W85-00401

AQUATIC CRYPTOGRAMS OF NATURAL ACID SPRINGS ENRICHED WITH HEAVY METALS: THE KOOTENAY PAINT POTS, BRITISH COLUMBIA,

Durham Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 2H.

INFLUENCE OF ACID PRECIPITATION ON BACTERIAL POPULATIONS IN LAKES.

Waste Treatment Processes—Group 5D

National Water Research Inst., Burlington (Ontar-io). Microbiology Labs. S. S. Rao, and B. J. Dutka. Hydrobiologia, Vol. 98, No. 2, p 153-157, January, 1983. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Acid rain, *Bacteria, *Water pollu-tion effects, *Turkey Lake, *Ontario, *Lake Huron, *Lake Erie, *Lake St. George, Nitrogen-reducing bacteria, Suffur bacteria, Organic matter, Alkalinity, Aerobic bacteria, Heterotrophic bacteria, Hydrogen ion concentration

ria, Hydrogen ion concentration.

Relative abundance of total, respiring, aerobic heterotrophic, nitrogen cycle, and sulfur cycle bacteria was measured in the acid-stressed Turkey Lake watershed (in Ontario) and compared to data collected from the relatively non-acid-stressed, hard water Lakes Huron, Erie, and St. George. The pH values in Turkey Lake ranged from 5.3 to 6.5, with an average of 6.0; the alkalinity value was 3.7 mg/L CaCO3. In non-acid-stressed lakes, pH ranged from 7.3 to 8.7, with an average of 8.2; the alkalinity value was 75 mg/L CaCO3. Data indicated that bacterial populations and densities were nearly an order of magnitude less in acid stressed waters than in non-acid stressed waters. Nitrifying bacteria and some sulfur cycle bacteria (Thiobacillus sp.) were very low or absent in acid stressed waters. Surface sediments of acid stressed lakes contained 3 to 4 times more organic matter (340 mg organic matter per g dry weight sediment in Turkey Lake) than the amount found in the relatively more enriched lake. Acid-stressed conditions and a poor buffering system in the Turkey Lake watershed appear to have suppressed the bacterial populations and the subsequent degradative processes. (Collier-IVI) W85-00404

STRESSED STREAM ECOSYSTEM: MA-CROINVERTEBRATE COMMUNITY INTEG-RITY AND MICROBIAL TROPHIC RE-SPONSE,

Environmental and Chemical Sciences, Inc.,

P. F. Kondratieff, R. A. Matthews, and A. L. Buikema, Jr. Hydrobiologia, Vol. 111, No. 2, p 81-91, April, 1984. 6 Fig, 4 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Inverte-brates, *Microorganisms, *Stream biota, *Virginia, Industrial wastewater, Wastewater pollution, ATP, Chlorophyll a, Autotrophs, Heterotrophs.

A year-long study of a second-order stream in Southwestern Virginia was carried out from 1979-80. One of the objectives of the study was to evaluate the effects of sewage and electroplating plant effluent stress on the trophic response of aquatic invertebrate assemblages and microbial communities in the stream. Quantitative benthic samples were collected periodically at three reference stations and four stressed stations below the outfalls. Invertebrates were counted, identified taxonomically, and classified into functional group based on their feeding strategies. Ash-free dry weights were obtained for each functional group by data and station, and the number of density of by data and station, and the number of density of different taxa were calculated as well. Reference different taxa were calculated as well. Reference stations had diverse invertebrate assemblages; scrapers were well represented and all functional groups were present in reasonably equivalent proportions. Stressed stations were dominated by collector gatherers and filterers to the virtual exclusion of scrapers. The trophic status of the microbial community was determined by suspending artificial substrates in the stream for 1-week periods. The community that colonized the substrates was assayed for ATP and chlorophyll a, and an autotrophy index (AI) was calculated using these values. The autotrophic component of the microbial community was greatest at the reference stations, and the community became primarily heterophic below the outfalls. The AI correlated well and the community became primarily hetero-c below the outfalls. The AI correlated well tions, and the communay occasing processing processing the trophic below the outfalls. The AI correlated well with the proportion of scrapers. Aquatic invertebrate assemblages and microbial communities responded to stress by changing their trophic structure to fit best the available energy sources. Where heterotrophic microbes dominated, gathering and filtering invertebrates utilized the abundant organic matter. In areas where a mainly autotrophic microber bial community existed, scrapers, gatherers, and filterers were all present in balanced proportions. (Author's abstract) W85-00415

THERMAL ALTERATION OF STREAMS DRAINING CLEARCUT WATERSHEDS: QUANTIFICATION AND BIOLOGICAL IM-PLICATIONS, Pennsylvania State Univ., University Park. School

of Forest Resource

A. Lynch, G. B. Rishel, and E. S. Corbett. lydrobiologia, Vol. 111, No. 161-169, 1984. 6 Fig, Tab, 20 Ref.

Descriptors: *Water temperature, *Clearcutting, *Herbicides, *Thermal pollution, Forest management, Watershed management, Temperature effects, Logging, Environmental effects, Invertebrates, Fish, Trout.

Stream temperature alterations due to a commercial forest harvesting practice and a research treatment were quantitatively evaluated, Summer maximum stream temperatures averaged 1 C higher in the commercial clearcut and 9 C higher in the clearcut-herbicided watershed than in the forested control. The largest average monthly temperature increase on the commercial clearcut (2.2 C) occurred during April; on the clearcut-herbicided basin it occurred during June (10.5 C). The clearcut-herbicide treatment resulted in changes which could have a negative effect on the aquatic invertenterates and fish life of the stream. High maximum temperatures, large diel fluctuations, and temperatures above tolerance limits of aquatic organisms for long periods could be lethal to various organisms, including brook trout. Little change in the aquatic community would be expected with the slight stream temperature changes which occurred on the commercial clearcut. If anything, these small temperature changes, especially during the spring, may be beneficial. The increases in temperature could increase primary productivity, increasing available food for aquatic invertebrates and fish. (Moore-IVI)

EFFECT OF DOMESTIC SEWAGE ON SAND BEACH MEIOFAUNA AT GOA, INDIA, National Inst. of Oceanography, Panaji (India). Z. A. Ansari, A. Chatterji, and A. H. Parulekar. Hydrobiologia, Vol. 111, p 229-233, 1984. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater pollution, *Beaches, *Meiofauna, *Goa, *India, Invertebrates, Seasonal variation, Water pollution effects, Monsoons.

Mandovi estuary, which opens into the Arabian Sea near Panjim on the west coast of India, receives about 1,300 million liters of urban runoff annually. A section of beach of the estuary receiving domestic sewage through a nullah, was sampled for meiofauna. Samples were collected from stations along a decreasing gradient of sewage pollution during the premonsoon, monsoon and postmonsoon from February 1980 to January 1981. Nematodes dominated the fauna numerically at all stations, followed by harpacticoid copeogos, oligo-chaetes, polychaetes, and archiannelids. Other important groups were turbellarians and gastrotrichs. Most of the animals were confined to the top 5 cm of the sediment. A seasonal pattern was observed in the distribution of the fauna. Maximum density was during premonsoon and minimum density in in the distribution of the fatha. Maximum density in the monsoon season. There were significant spatial and temporal variations in mean meiofauna density, attributed to organic discharge via sewage and prevailing environmental conditions in the study area. Beach stability is an important factor. (Moore-IVI) W85-00423

NUTRIENTS OF THE SARONIKOS GULF IN RELATION TO ENVIRONMENTAL CHARAC-TERISTICS (1973-1976), Institute of Oceanographic and Fisheries Research,

Athens (Greece).

Hydrobiologia, Vol. 112, No. 1, p 17-25, May, 1984. 4 Fig. 4 Tab, 24 Ref.

Descriptors: *Saronikos Gulf, *Athens, *Greece, *Nutrients, *Water pollution effects, Nitrates, Phosphates, Effluents, Wastewater pollution, Marine environments, Seasonal variation, Stratifi-

Saronikos Gulf represents in many ways an excel-lent case for the investigation of the effects of urban waste disposal into an oligotrophic marine environment. The nutrient distribution in relation to environmental characteristics of the Saronikos to environmental cnaracteristics of the Sarchiscos Gulf was studied for the period 1973-1976 at two stations in the Gulf, an oligotrophic one in the Outer Gulf and an eutrophic one in the vicinity of the sewage outfall of the Greater Athens Area. The distribution of measured values and their spa-The distribution of measured values and their spatiotemporal variations were compared with previous data for the same area. Winter convection resulted in a very weak gradient of temperature, salinity, oxygen and nutrients. Stratification started to develop in May and persisted for about six months. Little seasonal variation of nutrients appeared to occur, with higher values generally in winter. The station in the vicinity of the outfall contained more phosphate and ammonia than the station in the source water. The levels of nutrients were similar in both years, except in the case of phosphate and nitrite, which were double at the station near the outfall in 1975. Of the nutrients controlling productivity in the photic layer of the stations in the Saronikos Gulf, phosphate had a stronger limiting effect on plant growth than inorganic nitrogen. The distribution of nutrients was closely correlated with the effluent-generated nutrient-field and its consequent wind-driven distribution. (Moore-IVI) tion. (Moore-IVI) W85-00424

5D. Waste Treatment Processes

PHOSPHORUS RENOVATION OF WASTEWATER BY OVERLAND FLOW LAND APPLICATION,

Maryland Univ., College Park. Dept. of Agrono-

R. R. Weil, and F. S. Payer.

R. R. Weil, and F. S. Payer.

Available from the National Technical Information
Service, Springfield, VA 22161, as PB84 19018,
Price code: A03 in paper copy, A01 in microfiche.
Maryland Water Resources Research Center Publication No. 74, August 1983. 33 p, 8 Fig, 5 Tab, 21
Ref. OWRT Project No. A-061-MD (1), Contract/
Grant No. 14-34-0001-2122.

Descriptors: *Wastewater treatment, *Wastewater disposal, Wastewater irrigation, Soil contamina-tion, Adsorption, Canarygrass, Reeds, Coastal Plains, *Land application, Monitoring.

A study was set up to monitor an operating over-land flow wastewater system on soils derived from clayey coastal plain sediments. Three treatments were imposed on the Reed Canarygrass (Phalaris canarlensis) cover; cut 4 times per year and leave residue; cut 4 times and harvest residue; and cut 1 time and leave residue. Effluent was sampled at 6, 12, 18, and 27 m from the point of application as well as from final collection weirs and directly from stray negrels. Inflow and cutflow rates were well as from final collection weirs and directly from spray nozzles. Inflow and outflow rates were monitored. Samples were collected on 8 dates at the beginning and end of each of 4 spray cycles consisting of 4-6 weeks of continuous spraying followed by a rest period of 4-6 weeks. Levels of total P in the applied effluent were low (1.5 mg/l) but application rates were high (15 to 23 cm/wk). The cutting treatments had no significant effects but application rates were high (15 to 25 cm/wk). The cutting treatments had no significant effect on P removal. While total soluble phosphorus (TSP) concentration in the applied wastewater ranged from 0.6 to 1.3 mg/l for the cycles, the 27 m flow distance was sufficient to consistently bring the TSP in the effluent down to about 0.3 mg/l. Averaged across all samples dates, TSP concentrations in the effluent were 0.91, 0.70, 0.52, and 0.32 mg P/L at the 6, 12, 18, and 27 m distances, respectively. W85-00076

Group 5D—Waste Treatment Processes

APPLICATION OF WASTEWATER TO WET-

East Carolina Univ., Greenville, NC. Dept. of

M. M. Brinson, and F. R. Westall.

M. M. Brinson, and F. R. Westall. Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190388, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Report No. 5, Land Treatment Series, August 1983. North Carolina State Univ., Raleigh. 27 p, 1 Fig. 11 Ref. OWRT Project No. B-123-NC (15), Contract/ Grant No. 14-34-0001-9144.

Descriptors: *Land treatment, *Wetlands, *Wastewater treatment, *Wastewater disposal, *North Carolina, Water quality standards.

The fifth of a series of five reports dealing with land (and wetland) treatment of wastewater and studge under the general guidance of a task force representing North Carolina regulatory agencies representing North Cartinia regulatory agencies and universities. Draft reports were critiqued by other specialists and practitioners at regional conference before publication. This report reviews the status of wetland treatment technology and examines its potential application in North Carolina and similar areas. Wetlands are viewed as valuable natural resources whose use for wastewater treat-ment should be limited to careful treatment in the context of water quality improvement not disposal. The report differs considerably from the other reports in this series in a more incomplete state of the art and the fact that wetlands contribute to the art and the fact that wetands controlle to water quality improvement in their natural state, provide valuable wildlife habitat, and function as important buffer zones between upland runoff and down stream receiving waters. Part I (Natural Wetlands) covers wetland types, hydrology, func-tional properties, and mechanisms of water quality Engineering) deals with regulation, Planning and Engineering) deals with regulatory issues, planning and design considerations, and artificial wetlands. An Appendix lists reference and additional ings. W85-00079

GENERAL GUIDELINES FOR SUBSURFACE

TREATMENT OF WASTEWATER, North Carolina State Univ., Raleigh. Dept. of Soil

C. G. Cogger, and A. R. Rubin

C. G. Cogger, and A. R. Rubin.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB84 190370,
Price codes: A03 in paper copy, A01 in microfiche.
North Carolina Water Resources Research Institute, Raleigh, Report No. 4, Land Treatment
Series, August 1983. 28 p, 16 Ref, 1 Append.
OWRT Project No. B-123-NC (14), Contract/
Grant No. 14-34-0001-9144.

Descriptors: *Land treatment, *Land disposal, Soil disposal, Fields, *Wastewater disposal, *Wastewater treatment, Septic tanks, *North Carolins, Water quality standards.

The fourth of a series of five reports dealing with land (and wetland) treatment of wastewater and sludge under the guidance of a task force representing. North Carolina regulatory agencies and universities. Draft reports were critiqued by other specialists and practitioners at regional conference before publication. The report provides general guidelines for the design and management of large subsurface wastewater treatment and disposal systems. While developed primarily for flows greater than 3000 gal. per day, many of the concepts apply than 3000 gal. per day, many of the concepts apply to smaller systems. Emphasis is on the land treat-ment part of the system rather than initial treatment units. Major sections include Waste Characment units. Major sections include waste charac-terization, Site Selection, Initial Treatment, Land Area Requirements, Absorption Area Design, and Maintenance and Monitoring. In addition to refer-ences, the Appendix discusses grass uptake of ni-trate and three models for determining nitrate loading rates. W85-00080

GENERAL GUIDELINES FOR LAND TREAT-MENT OF SLUDGE,

North Carolina State Univ., Raleigh. Dept. of Soil

Science.
L. D. King, and P. W. Westerman.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB84 190362,
Price codes: A03 in paper copy, A01 in microfiche.
North Carolina Water Resources Research Institute, Raleigh, Report No. 3, Land Treatment Series, August 1983. 37 p, 2 Fig, 6 Tab, 12 Ref, 1
Append. OWRT Project No. B-123-NC (13), Contract/Grant No. 14-34-0001-9144.

Descriptors: *Land treatment, *Land disposal, *Sludge disposal, Sludge treatment, North Carolina, Water quality standards.

The third of a series of five reports dealing with the land (and wetland) treatment of wastewater and sludge prepared under the general guidance of a task force representing North Carolina regulatory agencies and universities. Draft reports were critiqued by other specialists and practitioners at regional conference before publication. This booklet presents a discussion of land treatment of sludge and general guidelines for design and management of related land treatment systems. It does not present detailed standards and attempts to leave maximum latitude for design by competent professionals. Introduction covers basic considerations and general design principles. Major sections include Sludge Characterization, Site Evaluation and Requirement, System Management, Monitoring Requirements, and Public Health Protection. An Appendix lists sources of materials and information The third of a series of five reports dealing with Appendix lists sources of materials and information and reference literature. W85-00081

POLICIES AND PROCEDURES FOR LAND

TREATMENT OF WASTEWATER,
North Carolina Dept. of Natural Resources and
Community Development, Raleigh. Div. of Environmental Management.
W. L. Fleming, D. H. Howells, and F. J. Humenik.
Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161 as PB84 190230, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Report No. 1, Land Treatment Series, August 1983. North Carolina State Univ., Raleigh. 11 p. OWRT Project No. B-123-NC (11), Contract/Grant No. 14-34-0001-

Descriptors: *Land treatment, *Land disposal, *Wastewater disposal, Wastewater farming, Wastewater irrigation, *Wastewater treatment, Wetlands, *North Carolina, Water quality stand-

The first of a series of five reports dealing with the The irst of a series of five reports dealing with the land (and wetland) treatment of wastewater and sludge prepared under the general guidance of a task force representing the North Carolina Agricultural Research and Extension Services, Water Resources Research Institute, Division of Environmental Measurement of Property of Harbit Sources and Property of Harbit Sources mental Management, and Division of Health Services. Draft reports were presented at a regional workshop for critique and input from other sources. Policies and Procedures for Land Treatsources. Policies and Procedures for Land Treatment of Wastewater introduces the series and discusses public acceptance, North Carolina Statutes and Regulations, Administrative Permitting Procedures and Requirements, and the availability of Advisory and Technical Assistance. The series as a whole provides general guidelines for the design and management of land treatment systems. It does not present detailed standards and attempts to leave maximum latitude for alternative designs by competent professionals. The guidelines should be reviewed periodically to keep abreast of state-of-the-art developments. the-art developments W85-00082

GENERAL GUIDELINES FOR LAND TREAT-

GENERAL GUIDELINES FOR LAND TREAT-MENT OF WASTEWATER, North Carolina State Univ., Raleigh. Dept. of Bio-logical and Agricultural Engineering. P. W. Westerman, and L. D. King. Available from the National Technical Information Service, Springfield, VA 22161, as PB84 190354, Price codes: A04 in paper copy, A01 in microfiche.

North Carolina Water Resources Research Institute, Raleigh, Report No. 2, Land Treatment Series, August 1983. 51 p, 2 Fig, 3 Tab, 23 Ref, 1 Append. OWRT Project No. B-123-NC (12), Contract/Grant No. 14-34-0001-9144.

Descriptors: *Land treatment, *Land disposal, *Wastewater disposal, Wastewater farming, *Wastewater treatment, *North Carolina, Water quality standards.

The second of a series of five reports dealing with the land (and wetland) treatment of wastewater and sludge prepared under the general guidance of a task force representing North Carolina regulatory agencies and universities. Draft reports were critiqued by other specialists and practitioners at regional conference before publication. This booklet presents a discussion of land treatment of wastewater effluent and general guidelines for design and management of related land treatment systems. It does not present detailed standards and systems. It does not present detailed standards and attempts to leave maximum latitude for innovative attempts to leave maximum latitude for innovative design by competent professionals. Introduction includes basic considerations for design, general design principles, and system alternatives. Major sections include Wastewater Characterization, Site Evaluation and Selection, Site Assimilative Capacity and Land Treatment, System Management, Monitoring Requirements, Public Health Protection, and Economic Considerations. An Appendix lists sources of materials and information useful in designing land treatment systems, as well as referenced. designing land treatment systems, as well as reference literature on land treatment.

DETECTION OF INDUSTRIAL POLLUTANTS AND TOXIC CHEMICAL WASTES IN SEWAGE TREATMENT PLANT INFLUENTS BY USE OF A BIOLOGICAL MONITOR,

Pennsylvania State Univ., University Park. Dept. of Microbiology, Cell Biology, Biochemistry and

L. J. McElroy. Applied and Environmental Microbiology, Vol. 45, No. 2, p 730-732, February, 1983. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Wastewater treatment facilities, *Pollutant identification, Industrial wastes, Toxicity, Anaerobic digestion, Bioindicators, Spirillum.

Sanitary sewage systems associated with industrial communities are often subject to industrial chemical wastes which can cause a partial or complete inhibition of anaerobic digestion upon receipt at the treatment plant. In such cases, raw or partially the treatment plant. In such cases, raw or partially treated sewage sludge must be diverted to holding basins until digester activity can be restored. A simple prewarning system for detecting potentially detrimental inhibitory materials would allow the timely diversion of influent, thus protecting plant operating systems. Heterogeneous mixtures of toxic chemical wastes affecting the normal operation of a sewage treatment facility employing anaerobic digestion were detected by dark-field ameriode algestion were detected by dark-field observation of uncoordinate flagellar orientation patterns displayed by cells of Spirillum volutans. These results were compared with plant parameters determined by gas production, volatile fatty acids, and alkalinity measurements and the method was found successful for this plant. (Baker-IVI) W85-00107

APPLICATION OF A COMBINED CHEMICAL BIOLOGICAL TREATMENT TO HIGH-STRENGTH WASTEWATER,

Osaka City Inst. of Public Health and Environ-mental Sciences (Japan). K. Takamizawa, and A. Honda.

Journal of Fermentation Technology, Vol. 60, No. 5, p 447-456, 1982. 18 Fig. 2 Tab, 14 Ref.

Descriptors: *Biological wastewater treatment, *Coagulation, *Combined treatment, *Activated sludge process, Biological oxygen demand, Sludge, Ferric chloride, Wastewater treatment, Solid wastes, Hydrogen ion concentration.

Ultimate Disposal Of Wastes-Group 5E

A method for treating high-strength wastewater effectively in a smaller scale plant and also for decreasing BOD to below the acceptable limit (300 mg/l) for sewage works at a practically low cost was developed. Wastewater generated by the dewatering process for a slurried-mixture of crushed-refuse and sewage sludge was used as high-strength wastewater. A combined chemical-biological treatment using direct addition of a ferric chloride solution (a consulant) to an acception. ferric chloride solution (a coagulant) to an aeration tank of activated sludge was more efficient compared with the conventional activated sludge treatpared with the conventional activated sludge treatment. The optimum pH in the aeration tank for the combined chemical-biological treatment was 5-6. Under this pH, the limitation of BOD-MLVSS (Mized Liquor Volatile Suspended Solids) loading to obtain an effluent BOD value below 300 mg/l was increased from 1 kg BOD/kg MLVSS/day for the conventional activated sludge treatment to 4 kg BOD/kg MLVSS/day. For the combined chemical-biological treatment, the calculated value of BOD removal coefficient (Kr) was 0.00057 (1/h MLVSS mg/l), the value of the biomass growth coefficient (Y) was 0.41 (g MLVSS/g BOD), and the biomass-decay coefficient (Kd) was 0.38 (1/day). For the conventional activated sludge treatment the values were 0.00030 (1/h MLVSS mg/l), 0.59 (g MLVSS/g BOD), and 0.06 (1/day), respectively. BOD removal was faster in the combined treatment than in the conventional treatment. To tively. BOD removal was faster in the combined treatment than in the conventional treatment. To obtain the same treatment efficiency, the combined system could accept two times greater loading than the conventional system with the same aeration tank volume and the same mass of activated sludge. (Collier-IVI) W85-00172

BATCH REACTOR ACTIVATED SLUDGE TREATMENT OF MILK PROCESSING WASTEWATERS, Cleveland State Univ., OH. Dept. of Civil Engi-

Process Biochemistry, Vol. 19, No. 1, p 25-28, February, 1984. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Dairy industry, *Activated sludge process, *Milk, *Batch reactors, Industrial wastewater, Biological wastewater treatment, Organic compounds, Chemical oxygen demand, Microorganisms.

A laboratory study was performed using batch activated sludge reactors to determine the organic removal rates from milk wastewaters and to determine the kinetic coefficients for biological treat-ment. Five batch bench-scale activated sludge reactors of 1 I volume were used in this investigation. Wastewater strength in the reactors were 0, 1, 3, 5, wastewater strength in the reactors were 0, 1, 3, 7, and 10 g of powdered milk per liter of reactor content. The COD removal efficiency decreased with increase in F/M (food to microorganism) ratios. Percent COD removal was 87% at a F/M ratio (based on COD removal) of 0.73, and was 68% at a F/M ratio of 1.865. The oxygen utilization coefficients, a' and b', were determined to be the coefficients, a' and b', were determined to be considered to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b', were determined to be the coefficients a' and b' are the coefficients a' and a' are the coefficients a' and a coefficients a' and o5% at a F/M ratio of 1.865. The oxygen utiliza-tion coefficients, a' and b', were determined to be 0.9 and 1.7/h. The sludge production coefficients, a and b, were found to be 0.483 and 0.14/day. The substrate removal rate constant, k, was 11.5/day, and the quantity of non-biodegradable material, y, was predicted to be 30 mg/l. (Author's abstract) W85-00212

RECOVERY OF HOT WATER, DYES AND AUXILLIARY CHEMICALS FROM TEXTILE WASTESTREAMS,

Clemson Univ., SC. J. J. Porter, and G. A. Goodman. Desalination, Vol. 49, No. 2, p 185-192, February, 1984. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Textile mill wastes, *Membrane hyperfiltration, *Water reuse, Wastewater renovation, Wastewater treatment, Filtration, Dyes, Membrane processes

The recovery of hot water, dyes and auxiliary chemicals from a continuous dye range has been demonstrated using a full-scale dynamic membrane hyperfiltration (HF) system. The membrane stability, flux, and rejections are satisfactory. Recycle of

88-96% of the wash water has occurred thus far and the remainder is suitable for normal waste treatment and discharge. Reuse of the dye pad drops and HF concentrates is possible; the eventual amount will depend on the type of dyes and run length. Plant operator experience and color matching problems will also determine practical limits of concentrate reuse. A means has been evaluated on a pilot scale whereby any residual dye liquor and concentrate can be reduced to an officially innocurous solid suitable for landfill application or perhaps agricultural use. By this means it is possible to approach zero discharge. (Baker-IVI) W85-00252

REVERSE-OSMOSIS MEMBRANE FOR TEST-ING COAL-LIQUEFACTION WASTEWATER,

Kentucky Univ., Lexington. D. Bhattacharyya, M. Jevtitch, J. K. Ghosal, and

Environmental Progress, Vol. 3, No. 2, p 95-102, May, 1984. 9 Fig, 6 Tag, 19 Ref.

Descriptors: *Membrane processes, *Filtration, *Water reuse, *Coal liquefaction wastewater, Wastewater treatment, Membranes, Reverse osmosis, Chlorides, Phenols.

The development of low-pressure membrane-separation processes for the purpose of permeate-water reuse is gaining considerably importance because of the feasibility of simultaneous removal of organic and inorganic dissolved solids. The treatment scheme for the coal-liquefaction wastewater calls for: H2S-NH3 stripping, phenolics extraction, powdered activated carbon-assisted biological processes, followed by a low pressure membrane separation process. Two types of membranes were evaluated: a polyamide hollow-fiber module and a spiral-wound module containing a thin-film composite membrane. The membranes were evaluated in terms of water flux, specific rejections of solutes and extent of water recovery. Both membranes in terms of water flux, specific rejections of solutes and extent of water recovery. Both membranes removed 94-98% organics at zero to 90% water-recovery levels. At low water-recovery levels the chloride rejections were: 98% with the spiral-wound module and 94% with the hollow-fiber module. At 90% water recovery, 91% chloride removals were obtained with the spiral-wound module compared to 80% removal with the hollow-fiber module. As these membranes also hollow-fiber module. As these membranes also provide efficient removals of phenolics and salts, it is possible that the indirect use of membranes withpossible that the indirect use of membranes with-out prior biological treatment may be feasible to produce adequate permeate quality for reuse. (Baker-IVI)

ADVECTION-DISPERSION INTERPRETA-TION OF TRACER OBSERVATIONS IN AN

AQUIFER, Stanford Univ., CA. Dept. of Applied Earth Sci-For primary bibliographic entry see Field 4B. W85-00326

DEGRADATION OF PHENOLIC CONTAMI-NANTS IN GROUND WATER BY ANAEROBIC BACTERIA: ST. LOUIS PARK, MINNESOTA, Geological Survey, Menlo Park, CA. G. G. Ehrlich, D. F. Goerlitz, E. M. Godsy, and M. F. Hult.

Ground Water, Vol. 20, No. 6, p 703-710, November-December, 1982. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Groundwater pollution, *Phenols, *Bacteria, *St. Louis Park, *Minnesota, Wastewater treatment, Anaerobic conditions, Coal mine wastes, Methane, Carbon dioxide, Naphtha-

Studies of contaminated near surface ground water at St. Louis Park, Minnesota indicate that coal tar derivatives from a coal tar distillation and wood treating plant operated there from 1918 to 1972 have entered the water and that phenolic compounds are being converted to methane and carbon dioxide by anaerobic bacteria. The findings which support this conclusion are: methane is present in the contaminated portions of the aquifer but not

elsewhere; methane producing bacteria are present in areas where methane is found but not elsewhere; and methane is produced from aqueous extracts of fluid from Well W13 inoculated with microbes from the contaminated zone and incubated under anaerobic conditions. Under the ambient conditions of the groundwater, over 95% of both the total recoverable phenolic compounds (TRP) and the phenolic compounds are removed within 1,000 m of the contamination source. Although dilution, dispersion and exchange effects may be operating, these cannot alone account for the observed attenuation of TRP and total organic carbon relative to sodium. Sorption of TRP on aquifer sediments as a single cause of the observed attenuation is unlikely as independent measurements on lab columns showed that phenol is not significantly sorbed. Chemical analyses show that naphthalene also exhibits a differential attenuation in concentrations relative to the sodium tracer, but the effect is less pronounced. The contaminated drift seems to be acting as a treatment zone for removal of phenolic compounds that have penetrated the aquifer. It can be characterized as a continuous flow bioreactor consisting of a fixed film microbial population fed by a multiple sutrient steam (Baker, IVI). eactor consisting of a fixed film microbial popula-tion fed by a multiple nutrient stream. (Baker-IVI) W85-00348

NITROGEN AND PHOSPHORUS INTER-CHANGE BETWEEN SEDIMENTS AND OVERLYING WATER OF A WASTEWATER RETENTION POND,

Agricultural Research and Education Center, Sanford, FL. K. R. Reddy. Hydrobiologi

Hydrobiologia, Vol. 98, No. 3, p 237-243, February, 1983. 3 Fig, 5 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Retention ponds, *Nitrogen, *Phosphorus removal, Temperature, Solar radiation, Turbulence, Floodwater, Sediment-water interface, Volatilization, Soil

Nitrogen and P interchange between the sediments and the overlying water of a stimulated retention pond used for wastewater treatment were evaluated under conditions of seasonal temperature fluctuations and varying physico-chemical conditions (exposing floodwater surface to daylight vs. dark and turbulent vs. quiscent floodwater). Natural sediment columns obtained from two types of field retention ponds were used. One type of retention pond consisted of calcareous clay loam sediment while the sediment of second retention pond contained organic soil. Nutrient interchange between sediments and the overlying water was measured once a month over a period of one year. Nitrogen removal rates from floodwater were controlled by the initial floodwater NH4(+) and NO3(-) concenthe initial floodwater NH4(+) and NO3(-) concentration, rate of NH4(+) diffusion from the sediments to the overlying water, ammonification in the sediments, NH3(-) volatilization and nitrificathe sediments. NH3(-) volatilization and nitrifica-tion at the sediment-water interface, and denitrifi-cation in the sediments. Under the conditions stud-ied, NH4(+) concentrations of the floodwater-were in the range of 0.01 to 0.05 micro g/ml, while NO3(-) concentrations were in the range of 0.27 to 0.78 micro g/ml. Sediments with organic soil were found to be less effective in the removal of flood-water organic N, organic C and P, compared to the sediments with calcareous clay loam. Phospho-rys exchange rates were dependent on the capacity rus exchange rates were dependent on the capaci of the sediment to adsorb or desorb P. Total or the sediment to adsorb or desorb P. Total P exchange rates were in the range of -1.04 to 0.34 mg P/sq m day. Seasonal temperature fluctuations, turbulent vs. quiescent water conditions or exposing the floodwater surface to daylight or dark had very little effect on N and P exchange rates. (Author's abstract) thor's abstract)

5E, Ultimate Disposal Of Wastes

SEDIMENT BUDGET STUDY FOR CLAM-SHELL DREDGING AND DISPOSAL ACTIVI-

Army Engineer District, New York. J. F. Tavolaro.

Group 5E—Ultimate Disposal Of Wastes

Report (1982). 27 p, 22 Fig, 5 Tab, 29 Ref.

Descriptors: *Dredging, *Ocean dumping, *Marine sediments, *Sand, *Municipal wastes, Barges, Turbidity flow, Turbidity, Physical properties, Sediment-water interfaces, Boats, *New York, New York Bight, Mud Dump site, New

The sediment budget study represented one aspect of the investigation of ocean disposal of dredged material for the Port of New York and New Jersey. Approximately 500,000 cubic yards of dredged material from six separate locations were disposed at one previously unused location at the dreuged material from six separate locations were disposed at one previously unused location at the Mud Dump Site. The material was capped with a layer of 252,000 cubic yards of 'clean fine-grained dredged material and 1,533,000 cubic yards of sand from Ambrose Channel. Approximately 2.0% of the dredged material was lost at the dredging site. the dredged material was lost at the dredging site. Of this lost dredged material, 55% was due to the dredging isself and 44.3% was due to intentional barge overflow. Approximately 3.7% of the dredged material is lost at the Mud Dump Site, presumably during disposal. Total loss of dredged material during these camshell dredging and ocean disposal operations was calculated to be 5.6%. Observations revealed that turbidity plumes generated at dredging sites were local features which traveled along the bottom for several hundred feet. These plumes only persisted while dredging was occurring, and ambient conditions were established within a relatively short time after dredging ceased. Of the total quantity of dredged material which is allowed to overflow from the barges, 57.2% settles back to the bottom in a material which is allowed to overhow from the barges, 57.2% settles back to the bottom in a relatively short time. It appears as if dredging itself is the major contributor to the loss of dredged material at the dredging site. (Garrison-Omniplan)

EVALUATION OF CAPPING OPERATIONS AT THE EXPERIMENTAL MUD DUMP SITE, N.Y. BIGHT APEX, 1980, New York Univ. Medical Center, NY. Inst. of Environmental Medicine.

J. M. O'Connor.

Final Report to U.S. Army Corps of Engineers, New York District, December 1982. 70 p, 6 Fig, 7

Descriptors: *Dredging, *Ccean dumping, *Chemical analysis, *Municipal wastes, *Municipal wastewater, *Contamination, Bioaccumulation, Sand, Accumulation, Biochemical characteristics, Biochemical tests, *New York, New York Bight, Mud Dump site.

Conflicting multiple uses of the New York Digminpose various stresses on its physical and biologized resources. Current regulations dictate that contaminated waste dredged material be given special treatment. Contaminated sediment from dredging the Hudgen estuary. Newark Bay, and Conflicting multiple uses of the New York Bight treatment. Contaminated secument from dreaging projects in the Hudson estuary, Newark Bay, and contiguous waters were capped with fine sediment and sand from the Bronx River, Westchester Creek and the Ambrose Channel. The capping resulted in a layer of sand about one meter thick lying atop the contaminated sediment. It was determined that the contaminated sediment. It was determined that a sand-mud cap was successfully placed at the experimental dumpsite. The cap was still intact and in place after at least sixteen months. Cap erosion was minor; predictions of cap life were in excess of twenty years under normal meteorologic conditions. Major storm events, however, are capable of eroding the cap and exposing the contaminated material. During the sixteen months of the study, the total loss of contaminated material was about 4%; all this loss occurred during the dumping/deposition/compaction phase. Chemical analyses showed that contaminant levels in the sand cap were much lower than in the contaminated sediments. Bioaccumulation studies showed that less contaminant uptake occurred at the capping site ments. Bioaccumulation studies showed that less contaminant uptake occurred at the capping site than at uncapped dredged material sites, and at sites in New York Harbor. Bioaccumulation rates were, for the most part, 0.1 or less. (Garrison-Omniplan) W85-00049

IDENTIFYING CHEMICAL SIGNATURES FOR DISPOSED DREDGED MATERIALS,

New York Univ. Medical Center, NY. Inst. of Environmental Medicine. Final Report to U.S. Army Engineers, New York District, June 1982. 77 p. 59 Ref, 3 Append.

Descriptors: *Chemical analysis, *Ocean dumping, *Contamination, *Dredging, *X-rays, *Sediments, *Continental shelf, Heavy metals, Zinc, Metals, Municipal wastes, *New York, Staten Island, New York Bight, Mud Dump site.

Contaminants dumped at sea on the continental shelf within the confines of the designated Dredged Material Dumpsite were analyzed, including subaquaceous burial of dredged material. The analysis was of physical and chemical characteristics of sediments from 10 dredging projects and 11 cores from the Mud Dump, Level of chemical contamination were greatest for metals, especially zinc; PCB levels were roughly similar throughout the projects. Unique chemical signatures were determinable for the Staten Island project, due primarily to very high levels of metals, particularly zinc. Chemical and physical analyses of core samples showed the presence of a sand cap of varying thickness. X-ray analyses of vibracore samples taken at the Mud Dump Site also demonstrated the presence of a sand cap; the depth of the cap was variable and ranged from a few centimeters to more than one meter. No samdepth of the cap was variable and ranged from a few centimeters to more than one meter. No sam-ples from dredging projects were found to contain unique chemicals. Levels of organic and inorganic contaminants at the Mud Dump Site were equiva-lent to levels detected in the analysis of samples from individual dredging projects. Where the sand cap was found to be in place, contaminant levels in the sand, and thus in contact with the water column were greatly reduced. The use of containing the same greatly reduced. The use of containing the same greatly reduced. The use of containing the same greatly reduced the use of containing the same greatly reduced the use of containing the same same treatly reduced. the sand, and thus in contact with the water column, were greatly reduced. The use of contami-nated sediments for capping made it difficult to draw any conclusion regarding the extent to which successful capping occurred through the region under study. (Garrison-Omniplan) W85-00350

SEDIMENT CAP STABILITY STUDY, NEW YORK DREDGED MATERIAL DUMPSITE,

YORK DREDGED MATERIAL DUMPSITE, National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
G. L. Freeland, R. A. Young, G. Drapeau, T. L. Clarke, and B. L. Benggio.
Report prepared for the Dept. of the Army, New York District Corps of Engineers, and the Office of Marine Pollution Assessment, NOAA, February 1983. 209 p, 81 Fig, 12 Tab, 74 Ref.

Descriptors: *Ocean dumping, *Municipal wastes, *Dredging, *Sediments, *Marine sediments, Sand, Storms, Fetch, Waves, Economic aspects, *New York, *Sediment transport, New York Bight.

The area under study had dredged material dumped which was determined, after the dumping occurred, to be unsuitable for unrestricted ocean occurred, to be unsuitable for unrestricted ocean disposal under the ocean dumping pollution criteria. This material was subsequently capped by clean dredged material. The sea-bottom conditions on the surface of the cap were measured. Both actual and predictive analysis indicated a slight amount of erosion occurring during a 'normal' year. The bottom is particularly susceptible to erosion during the winter season, when the water column is unstratified. Especially important for bottom sediment transport are storm conditions. bottom sediment transport are storm conditions when the wind blows from directions of open water fetch (from east-northeast to south-south-west). Sea swell coming from these directions may west). Sea swell coming from these directions may also cause some transport. Severe conditions did not occur during the measurement period; nevertheless, some sediment transport, primarily to the south, did occur. Since the present surface of the cap contains high percentages of easily transported find sand, it is recommended that additional material be added to the cap, and that this material be clean sand as coarse as is economically available, but not finer than 0.25 mm in grain size. The wave hindcasting technique used correlated very well with bottom measurements, but at least one bottom with outloin measurements, but at least one bottom transport event corresponded with a time of sea swell, not locally generated wind waves. The cap, which is four to eight feet thick, appears to be safe for the time being. (Garrison-Omniplan) W85-00053 AREAS SUITABLE FOR APPLICATION OF MUNICIPAL SLUDGE.

Fox Valley Water Quality Planning Agency, Menasha, WI.

Report, July 1983. 20 p, 104 Maps, 11 Tab, 4 Ref.

Descriptors: *Sludge utilization, *Sludge disposal, Liquid sludge, Sludge solids, *Sludge drying, *Wastewater disposal, *Municipal wastewater, Slopes, Municipal wastes, Industrial wastes, Per-meability, Bedrock, *Wisconsin, Maps, Land appli-cation.

Sites near Menasha, Wisconsin, that were potentially acceptable for the land application of municipal wastewater treatment sludges were analyzed, using two main criteria: (1) the land had to be outside of existing urban development, to avoid conflicting land use problems, and had to be located within a reasonable distance from the municipal treatment plant; and (2) detailed soil and topographic standards had to be met. These standards included: less than 12% slope, depth to seasonal water table greater than three feet, no flooding or water table greater than three feet, no flooding or water table greater than three feet, no flooding or ponding, depth to bedrock greater than three feet, permeability of the most restricting layer to be above three feet of 0.2 to 5.0 in. per hour, and available water capacity to be more than three inches based on a 60-inch column of soil. Maps showing suitability for sludge application maps are included for Brown, Calumet, Fond du Lac, Outaamicuned for Brown, Caiumet, Fond du Lac, Outa-gamie, and Winnebago Counties. A landowner in-terested in spreading sludge must be aware of the particular solids present in the fields and the limita-tion of these soils for the land application of sewage sludge. Other concerns such as the per-centage of slope, proximity to a waterway, and climatic conditions are also involved in the deci-sion. Some treatment plants have a policy of haulsion. Some treatment plants have a policy of hauling the sludge to the farmer's field and dumping it onto the field; others not only haul the sludge to the field but also spread in onto the land. Liquid sludges demand different application equipment than dewatered sludge. (Garrison-Omniplan) W85-00054

DISPOSAL OF SECONDARILY TREATED MUNICIPAL SEWAGE BY SUBSURFACE IRRIGA-

Maryland Univ., College Park. Dept. of Agricul-

tural Engineering.
L. E. Stewart, D. S. Ross, H. L. Brodie, and T.

Sonration Available from the National Technical Information Service, Springfield, VA 22161 as PB8 190081, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Technical Report No. 70, August 1983. 19 p, 5 Fig. 6 Ref. Project No. OWRT A-055-MD(1), Contract/Grant No. 14-34-0001-2122.

Descriptors: *Subsurface irrigation, Sprinkler irrigation, *Septic waste water, Chlorination, Trickling filters, Biological wastewater treatment, Sand filter, Secondary wastewater treatment, Tertiary wastewater treatment, *Wastewater treatment, *Wastewater disposal.

Trickle irrigation tubing was used for low pressure, uniform subsurface distribution of chlorinated sewage effluent for land treatment and disposal. sewage effluent for land treatment and disposal. The effluent was domestic, secondarily treated water from a septic tank and sand filter system. The land provided tertiary treatment of the water through growing plants, evaporation, and groundwater recharge. This method eliminated a point source discharge into a stream and appears to have future application. This experimental system performed well in the fall of 1992 and, with modification in 1992. Although the courses stickly interesting in 1993. tormed well in the fall of 1982 and, with modifica-tion, in 1983. Although the rowcrop trickle irriga-tion tubing (tape) appeared to function satisfactori-ly in a heavy soil containing stones, rigid well trickle tubing may be advantageous in problem soils or at deeper depths. Effluent was evenly distributed without surface wetting for all treat-ment amplication, rates that precipitation was very ment application rates but precipitation was very low during the test period. This system appeared to allow good utilization of effluent nutrients because plant roots were not saturated. This system may have application in urban areas where the surface can be used for public green space. Dispos-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration-Group 5F

al can be under turfgrass in parks or under forage crops with lower pumping energy than by an overhead sprinkler system. W85-00065

MEASUREMENTS TO QUANTIFY WASTEWATER FIELDS PRODUCED BY OUT-

Michigan State Univ., East Lansing. Dept. of Civil Engineering. For primary W85-00067 bibliographic entry see Field 5B.

APPLICATION OF WASTEWATER TO WET-

East Carolina Univ., Greenville, NC. Dept. of Basi Carolina Only, Greenvine, RC. Dept. of Biology.
For primary bibliographic entry see Field 5D. W85-00079

GENERAL GUIDELINES FOR SUBSURFACE TREATMENT OF WASTEWATER,
North Carolina State Univ., Raleigh. Dept. of Soil

Science. For primary bibliographic entry see Field 5D. W85-00080

GENERAL GUIDELINES FOR LAND TREAT-MENT OF SLUDGE, North Carolina State Univ., Raleigh. Dept. of Soil

Science.

For primary bibliographic entry see Field 5D. W85-00081

POLICIES AND PROCEDURES FOR LAND TREATMENT OF WASTEWATER, North Carolina Dept. of Natural Resources and

Community Development, Raleigh. Div. of Envi-ronmental Management. For primary bibliographic entry see Field 5D. W85-00082

GENERAL GUIDELINES FOR LAND TREAT-MENT OF WASTEWATER,

North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering. bibliographic entry see Field 5D.

NATURAL BUFFERS FOR SLUDGE LEACH-ATE STABILIZATION.

s and Moore, Washington, DC. K. S. Makeig. Ground Water, Vol. 20, No. 4, p 420-429, July-August, 1982. 3 Fig, 3 Tab, 42 Ref.

Descriptors: *Sludge disposal, *Buffer area, *Lea-chates, *Sludge entrenchment, Land disposal, Groundwater pollution, Soil properties, Cation ex-change, Nitrates, Permeability coefficient, Groundwater movement, Mathematical models.

Large quantities of sludge can be disposed of safely by burial in narrow trenches. This paper describes a study to quantify the amount of buffer area around a trenching operation that would allow for the natural soils to stabilize sludge leachate with out threatening the ground-water supplies of sur-rounding communities. A vertical buffer consists of rounaing communities. A vertical burier consists of a thickness of unsaturated soil below the base of the trench. Its thickness is calculated by comparing the cation exchange capacity of the soil with the exchangeable cations in the sludge leachate. Data from metropolitan Washington, D.C. consistently require a vertical buffer of less than 3 feet thick. A minimum of 3 feet of unsaturated soil is recom-mended as a margin of safety, although no specific studies were performed to reach this value. The horizontal buffer is a strip of land that must be maintained between the trenching operations and the site boundary. Its width can be more than two orders of magnitude greater than the vertical buffer. Its width is based on the nitrogen loading of the soil from the sludge and the mobility of nitrate in the upper aquifer based primarily on hydraulic conductivity and the characteristics of the sludge/

soil interaction. An advection-dispersion model predicts nitrate concentrations for various buffer widths, and is used in conjunction with a specified maximum allowable nitrate concentration to determine a minimum horizontal buffer under certain ground-water flow conditions. (Author's abstract) W85-00322

5F. Water Treatment and **Quality Alteration**

FREQUENCY DISTRIBUTION OF COLIFORMS IN WATER DISTRIBUTION SYS-

Drexel Univ., Philadelphia, PA. Dept. of Biologi-

R. R. Christian, and W. O. Pipes. Applied and Environmental Microbiology, Vol. 45, No. 2, p 603-609, February, 1983. 1 Fig, 4 Tab,

Descriptors: *Coliforms, *Drinking water, *Pennsylvania, *New Jersey, *Water distribution, Frequency distribution, Bacteria, Public health.

Nine small water distribution systems in Pennsylvania and New Jersey were sampled intensively to determine the patterns of dispersion of coliforms. Coliforms were not randomly dispersed in any of the water distribution systems. In all systems studied most locations yielded no coliforms. The frequency distributions of confirmed coliform counts were compatible with either the negative binomial or the lognormal distribution. They were not compatible with either the Poisson and Poisson-plus-added zeroes distribution. If the lognormal model is representative of the coliform distribution, the is representative of the colliform distribution, the arithmetic mean sample count is a poor estimator of the true mean coliform density. Also, the likeli-hood of a person consuming water with a very high coliform density is small but finite even if the system is not shown to be in violation. (Baker-IVI) W85-00106

TREATMENT OF CONTAMINATED GROUNDWATER WITH GRANULAR ACTI-VATED CARBON, R. P. O'Brien, M. M. Clemens, and W. G.

Schuliger.
AIChE Symposium Series, Vol. 79, No. 230, p 44-52, 1983. 14 Fig.

Descriptors: *Groundwater pollution, *Water treatment, *Activated carbon, *Pennsylvania, *To-byhanna Army Depot, *New Jersey, *Rockaway Borough, Potable water, Organic compounds, Lea-

Contamination of groundwater supplies in the United States with organic chemicals has become a serious widespread problem. In the granular carbon treatment of leachates and groundwaters generated from waste storage lagoons, industrial accidents, and transportation accidents, a total of 27 different organic compounds were detected. Treatment with granular activated carbon is a cost effective process for removing a wide range of organic compounds from contaminated leachates and groundwaters. Case histories for Rockaway Borrouch. New Jersey and the Tothyhanna Army Borough, New Jersey and the Tobyhanna Army Depot, Tobyhanna, Pennsylvania show that non-detectable levels of synthetic organic chemicals detectable levels of synthetic organic chemicals can be achieved in water supply systems with total operating costs as low as 22 cents per 1,000 gallons treated and carbon usage rates as low as 0.1 bbs per 1,000 gallons. Predicting the performance of granular carbon in groundwater treatment is no longer a time consuming or expensive operation. With the development of the Accelerated Column Test, potential granular carbon users can expect a more accurate system design in less time and for less money. (Baker-IVI)

INTEGRATION OF A REVERSE OSMOSIS IN-STALLATION IN THE FULLY AUTOMATED OPERATION OF A RURAL WATER SUPPLY

Eichsfelder Energie- und Wasserversorgungs G.m.b.H., Duderstadt (Germany, F.R.). F. Bergmann, and B. Schuette. Desalination, Vol. 49, No. 2, p 203-214, February,

Descriptors: *Reverse osmosis, *Water treatment, *Sulfates, *West Germany, Automation, Computers, Drinking water, Conductivity.

The Eichsfelder Energy and Water Supply Com-pany Limited is a service company in the northern section of the German Federal Republic. It supsection of the German Federal Republic. It supplies water to one city and 38 maller towns in Lower Saxony. The water is supplied from 6 deep wells. German drinking water regulations require that the sulfate content of drinking water not exceed 240 mg of SO4/I. Since the sulfate content in well water fluctuates considerably, a reverse cosmosis (RO) plant was added to the existing water treatment plant to provide sulfate ion removal capabilities. The RO plant consists of two trains each using a different type of RO membrane and producing 50 cu m/h (316.8 kpgd). The plant is fully automated and operated by computer based fully automated and operated by computer based on conductivity values of the blended product water and the water requirement. The remote water treatment plant is not staffed around the clock. All operating data are transmitted by radio to a central control room where the plant perform-ance is monitored on CRT. Water of nearly constant conductivity can be delivered to the supply net by using speed regulation motors. During nearly one year of operation (2,500 h) the RO plant has experienced no upsets. (Moore-IVI) W85-00253

WATER TREATMENT FOR WATERFLOOD INJECTION.

Effluent and Water Treatment Journal, Vol. 24, No. 4, p 140-142, April, 1984. 1 Fig, 1 Tab.

Descriptors: *Waterflood injection, *Water treatment, *Oil recovery, *Seawater, Filtration, Suspended solids, Deaeration, Dissolved oxygen, Organic compounds.

Secondary recovery techniques are used on oilfield reservoirs either to increase production rates or to stimulate older reservoirs which have lost pressure. stimulate older reservoirs which have lost pressure. The most common method of secondary recovery is waterflood injection in which water from a source external to the field is treated and injected at high pressure into the reservoir. Knowledge of the amount of suspended solids and their particle size distribution is very important, and before a water flood development takes place, the seawater at or near the eventual abstraction site is tested for these nearwaters so, that the outlings the statement of the seawater at or near the eventual abstraction site is tested for these parameters so that the optimum treatment process is selected. Seawater is usually abstracted parameters so that ure optimism treatments process is selected. Seawater is usually abstracted from about mid-sea depth to ensure the cleanest water. Any biological material is killed by the injection of chlorine and biocides at the pump to prevent growths in the treatment system and to enable the material to be removed by filtration. Waterflood injection requires very high quality filtered water as, under the normally large flow rates employed, the pressure of even quite low suspended solids and very fine particles would quickly lead to blockages in the injection wells and consequent falling off of injection rate. Backwashing of the filters uses unfiltered seawater when the suspended solids level is low thus eliminating the need for a backwash tank and pumps. Normally a single stage of the fine filtration is sufficient. Filter aids may involve the addition of a chlorine resistant polyelectrolyte. Dissolved oxygen must be removed from the water to be injected. A variety of moved from the water to be injected. A variety of chemicals is added to the injection water during the treatment process to control biological activity, to serve as filtration aids, to aid deaeration, and to reduce foaming in deaerators due to the presence of organic compounds. (Baker-IVI) W85-00273

GROUND WATER CONTAMINATION OF TWO PRODUCTION WELLS: A CASE HISTO-

Group 5F-Water Treatment and Quality Alteration

Ecology and Environment, Inc., Seattle, WA. K. Boateng, P. C. Evers, and S. M. Testa. Ground Water Monitoring, Vol. 4, No. 2, p 24-31, Spring, 1984. 9 Fig. 3 Tab, 7 Ref.

Descriptors: *Wells, *Groundwater pollution, *Lakewood, *Washington, *Chlorinated hydrocar-bons, Monitoring wells, Tetrachloroethylene, Dichloroethylene, Trichloroethylene, Water pollu-tion control, Organic compounds.

Ground water sampling in the summer of 1981 revealed that two production wells belonging to the Lakewood Utility District (Washington) were contaminated with chlorinated hydrocarbons. contammated with chiormated nyurocaronous. Testing revealed the source of the problem to be a commercial facility located a few feet northwest of a monitoring well. Contaminants identified included 1,2-(trans)-dichloroethylene, trichloroethylene, ed 1,2-{trans}-dichloroethylene, trichloroethylene, and tetrachloroethylene. Recommendations were that the contaminated discharge from the facility be eliminated; that the two contaminated wells be pumped at intervals and sampled to determine when acceptable levels of water purity were achieved; and that if reasonable levels were not achieved within a reasonable time, then cost-benefit studies of treatment or the use of alternate sources be made. (Baker-IVI) W85-00363

5G. Water Quality Control

PROJECTED EFFECTS OF PROPOSED CHLO-RIDE-CONTROL PROJECTS ON SHALLOW GROUND WATER-PRELIMINARY RESULTS FOR THE WICHITA RIVER BASIN, TEXAS, Geological Survey, Austin, TX. Water Resources

Available from the OFSS, USGS, Box 25425, Denver, CO 80255. USGS Water-Resources Investigation Report 83-4026, 1983. 40 p, 11 Fig, 2 Tab, 23 Ref.

Descriptors: *Groundwater, Water quality, *Natural chloride pollution, *Digital computer model, *Aquifer simulation, Aquifer-head changes, *Texas, Wichita River basin.

The U.S. Army Corps of Engineers' plan to control the natural chloride pollution in Wichita River basin includes construction of Truscott Brine Lake on a tributary of North Wichita River. In connection with the proposed brine lake, the U.S. Geological Survey was requested to define the existing ground-water conditions in the shallow freshwater ground-water conditions in the shallow freshwater system of the project area and to project the postconstruction effects of the proposed lake on the freshwater aquifer. The freshwater aquifer in the project area is a shallow water-table system with relatively freshwater that contains approximately 500-5,000 milligrams per liter of dissolved solids and consists of Permian rocks with very small values of hydraulic conductivity. It overlies a brine system that is even less permeable. Two-dimensional mathematical computer models were developed for aquifer simulation of steady-state conditions in a freshwater system and transient conditions in a brine-freshwater system where denominations of the state o conditions in a brine-freshwater system where density effects of the brine are considered. Main results of the project are: (1) Water-level rises in the aquifer of 5-40 feet would be confined to areas near the proposed dam and along lake shoreline, and (2) migration of saltwater downstream from dam gen-erally would be limited to less than 1 mile and apparently, would not reach equilibrium during the 100-year duration of the project. (USGS) W85-00026

ESTIMATION OF NONPOINT SOURCE LOADINGS OF PHOSPHORUS FOR LAKES IN THE PUGET SOUND REGION, WASHING-TON, Geological Survey, Tacoma, WA. Water Re-

sources Div For primary bibliographic entry see Field 5B W85-00038

WATER SUPPLY SOURCE PROTECTION RULES AND REGULATIONS PROJECT,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 6E.

GROUNDWATER: AN INVENTORY OF WELLS AND CONTAMINATION POTENTIAL WITHIN THE SILURIAN AQUIFER OF CALU-INVENTORY

Fox Valley Water Quality Planning Agency, Menasha, WI. S. C. Hansen

Report, July 1983. 120 p, 13 Fig, 17 Tab, 29 Ref, 1

Descriptors: *Groundwater availability, *Available water, *Water supply, *Subterranean water, *Coliforms, *Contamination, *Agricultural chemicals, Aquifers, Political aspects, Governmental interrelations, Interagency cooperation, Fertilizers, Groundwater quality

Concern over the quality of Wisconsin's ground-Concern over the quality of Wisconsin's ground-water supplies has recently increased due to inci-dents of contaminated drinking water sources. The presence of the pesticide 'aldicarb' in some wells in the Central Sands area of the state is but one example. Currently, two-thirds of the residences in the state rely solely on groundwater for their water supply. Most private drinking water systems in the state pump well-water from this reserve, as do about 560 out of 580 municipal water systems. The quality of groundwater within the Silurian aquifer of Calumet County was found to be gener-ally good and safe for human and livestock con-sumption, but excessive levels of nitrates and coli-form bacteria have been found in wells. Surface activities such as manure spreading, animal waste activities such as manure spreading, animal waste storage, solid waste landfilling, and pesticide and fertilizer applications are considered potential sources of contaminants. Large informational gaps exist on much of Wisconsin's groundwater sup-plies. It is recommended that Calumet County adopt policies stipulating land use or zoning re-strictions for activities which threaten groundwatstrictions for activities which threaten groundwater quality. The county should also initiate an informational program to inform landowners and the general public of activities which could degrade the quality of their groundwater. The proper design of manure storage facilities should be encouraged, and the Silurian aquifer groundwater should be sampled over a period of time to establish its existing quality and trends. (Garrison-Omniplan) plan) W85-00055

INVESTIGATION OF THE CARRYING CA-PACITY OF THE MONOCACY RIVER AS A SCENIC AND RECREATIONAL RESOURCE, VOLUME III. THE MONOCACY RIVER-ANALYSIS OF EXISTING SITUATION AND DECOMMENDATIONS. FOR DEPOCECTING RECOMMENDATIONS FOR PROTECTING THE RIVER RESOURCE,

Maryland Univ., College Park. Dept. of Recrea-For primary bibliographic entry see Field 6D. W85-00073

WATER QUALITY CONTROL.

G. Kovacs. Ambio, Vol. 13, No. 2, p 101-103, 1984. 4 Fig.

Descriptors: *Water quality control, *Hungary, *Lake Balaton, *Lake Velence, Wastewater treament, Industrial wastes, Canals, Eutrophication,

As in every industrialized country the control of water quality is a problem of water management in Hungary. The efficient treatment of effluents is eeded to protect the environment and also to develop water resources. The available natural water resources are limited and the ever increasi demand can be covered only if the repeated use of the water is ensured by the sufficient treatment of the effluents released into the water courses. Although transboundary pollution, along with a widening gap between water supply and sanitation, hinder the development of water quality control, some improvements have been attained. The im-

provement of water quality in Lake Velence, the second largest shallow lake in Hungary, is discussed. The eutrophication of Lake Balaton and the efforts to provide sewage treatment and restore the canals are considered. Apart from technical measures, which mostly involve the treatment of effuents, a regular observation of qualitative parameters, the localization and elimination of accidents and the administrative regulations for licensing the use of water, are all instruments for the improvement of water quality control. Multidisciplinary research is needed to establish a firm scientific basis for the ongoing protection of water tific basis for the ongoing protection of water resources. (Baker-IVI)

CONSERVATION OF FRESHWATER FISHES OF SRI LANKA,

California Univ., Davis. Dept. of Wildlife and Fisheries Biology. F. R. Senanayake, and P. B. Moyle.

Biological Conservation, Vol. 22, No. 3, p 181-195, March, 1982. 1 Fig, 3 Tab, 46 Ref.

Descriptors: *Conservation, *Fish, *Sri Lanka, Environmental effects, Deforestation, Urbaniza-tion, Watershed management, Translocation, Land use, Mining, Pesticides, Diversion, Fisheries, Legal aspects.

Sri Lanka supports a diverse fauna of freshwater fishes, 24% of which are endemic. A survey of the island's streams indicated that a number of the endemic fishes are threatened with extinction and others are depleted due to the interaction of defor-estation, urbanization, gem mining, pesticides, ex-ploitation, water diversions, and introduction of exotic species. It is important to conserve these endemic species for ethical, economic, and ecologi-cal reasons. Ways of achieving this goal are outcal reasons. Ways of schieving this goal are outlined. The endemic species considered included
two spot barb, black ruby barb, cherry barb, side
striped barb, blotched filamented barb, red scissortail barb, vateria flower rasbora, green carplet,
green labeo, banded mountain loach, spotted loach,
green topminnow, comb tail, ornate paradisfish,
and redtail goby. The distribution of fishes of Sri
Lanka suggest that there are three distinct ichthyological provinces: the Southwestern Province, the
Mahaveli Province, and the Dry Zone Province.
Legal machinery for protecting the fishes already
exists in Sri Lanka, under sections 34 and 37 of the
Fauna and Flora Protection Ordinance, as amend-Fauna and Flora Protection Ordinance, as amended by Act 44 of 1964 and approved by the National Assembly in 1972. Some of the steps that should be taken include captive breeding, watershed manage-ment, translocation, and regulation of fisheries. (Roker-IVI) W85-00118

LOCAL PROBLEMS BECOME NATIONAL ISSUE.

L. Tangley. BioScience, Vol. 34, No. 3, p 142-146 and 148, March, 1984. 3 Fig, 3 Tab.

Descriptors: *Groundwater pollution, *Water pollution control, Natural resources, Groundwater movement, Aquifers, Legislation.

Groundwater is a vast natural resource with aquifers that hold it underlying most of the United States. Groundwater comprises more than 96% of all fresh water in the United States. One well all fresh water in the United States. One well known characteristic of groundwater, particularly relevant to its contamination, is the speed that the water moves, anywhere from a few feet to just a fraction of an inch per day. Slow movement of contaminants also means that groundwater quality can differ dramatically from place to place. In addition, aquifer geology and natural groundwater quality vary locally, leading many researchers to believe that the resource is best managed at the state or local level. Many groundwater pollutants tend to be invisible, as well as being odorless and tasteless. Detection can be difficult. Often there are no surface water alternatives for communities that depend on groundwater. Testing of many contamidepend on groundwater. Testing of many contami-nants as possible carcinogens has not yet been completed. Such testing, particularly in humans, is

Techniques Of Planning-Group 6A

difficult. The complex microbial ecosystems contained in groundwater are discussed along with consideration of various sources of pollution and the EPA strategy for dealing with the problem. (Baker-IVI) W85-00125

TREATMENT OF CONTAMINATED GROUNDWATER WITH GRANULAR ACTI-VATED CARBON, For primary bibliographic entry see Field 5F. W85-00128

INTEGRATION OF FOREST AND LAKE FER-TILIZATION: TRANSPORT AND TRANSFOR-MATIONS OF FERTILIZER ELEMENTS,

MATIONS OF FERTILIZER ELEMENTS, British Columbia Ministry of Environment, Van-couver, Fish and Wildlife Branch. C. J. Perrin, K. S. Shortreed, and J. G. Stockner. Canadian Journal of Fisheries and Aquatic Scienc-es, Vol. 41, No. 2, p 253-262, February, 1984. 9 Fig. 6 Tab, 44 Ref.

Descriptors: *Mohun Lake, *British Columbia, *Forest fertilization, *Lake fertilization, *Nutrients, Cycling nutrients, Nitrogen, Phosphorus, Phytoplankton, Nitrogen transport, Chlorophyll,

Phytoplankton, Nitrogen transport, Chlorophyll, Ureas, Fertilizers.

Application of fertilizers to forests and to lakes has resulted in increased productivity in both systems. Forest fertilization by helicopter with a centrifugal spreader (435 kg urea/ha) on the Mohun drainage, northern Vancouver Island, during late fall 1979 resulted in a combined increase in urea, ammonia, and nitrate concentrations to 8000 micrograms N/L above control levels in streams not protected with 50-m-wide leave (i.e. unfertilized) strips and 350 micrograms N/L in those having leave strips. By spring 1980, dissolved nitrogen loads to Mohun Lake increased by a minimum of 55% in the largest basin and 1924% in the smallest basin. This corresponded to fertilizer losses of 2.1% of the total applied from drainages that had leave strips and up to 5.2% from those where the treatment included direct application to stream channels. Nitrogen transport was dominated by reduced nitrogen species and lasted up to 144 d. During the 3 yr prior to forest fertilization, nitrogen (ammonium nitrate) and phosphorus (ammonium phosphate) were added to the lake at an N:P ratio of 4.5 (wt/wt) and a load of 1.4.2.2 mg P/sq m/wk. Spring overturn whosphorus concentrations were 4-5 microgram. L throughout the study and, except during the spring following forest fertilization, N:P ratios (No3-N:TP) at spring overturn were 3-6 (wt/wt). Despite the low ratios, nitrogen-fixing phytoplankton were not dominant in Mohun Lake. The lake's phytoplankton community was nitrogen limited prior to the increased nitrogen supply. After forest fertilization, average epilimnetic chlorophyll concentrations were 1.8 times higher than in 1979, the last year of lake fertilization. The increase is attributed to the much higher spring recycling processes within the extensive littoral zone of the lake. (Collier-IVI)

MERCURY LEVELS IN BROOK TROUT (SAL-VELINUS FONTINALIS) FROM SELECTED ACID AND LIMED ADIRONDACK LAKES, New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Natural Resources. For primary bibliographic entry see Field 5C. W85-00204

DISPOSING OF POWERPLANT FLYASH CAN BE EFFECTED IN AN ENVIRONMENTALLY SAFE MANNER

Power, Vol. 128, No. 2, p 45-48, February, 1984. 4

Descriptors: *Fly ash, *Powerplants, *Landfills, *Delaware, Waste disposal, Waste dumps, Economic aspects, Groundwater protection, Air pollution control, Dusts, Monitoring, Leaching

Dry disposal of flyash as opposed to ponding was begun in Delaware with experience gained at the

Indian River station of the Delmarva Power and Light Company serving as a base. The Indian River station is a coal-fired plant comprising four generating units with nominal capacities for a total capacity of 757 MW. The plant consumes about 5150 tons/day of eastern bituminous coal. About 180,000 tons of day flyash and 32,000 tons of bottom ash are generated annually. Flyash is loaded into haul pan from the storage silo and transported to an on-site landfill by a contractor. The design of the landfill is based on a 30 yr plant life. The completed landfill will eventually cover about 140 acres, including sedimentation basin, access roads, perimeter dikes, and drainage ditches. Dust control measures are implemented at the landfill to minimize this problem. An emergency response plan has been developed for times when there are high winds at the landfill in the direction of adjacent landowners. An aerovane alarm system sounds an alert, which sets the plan in motion. Some of the environmental control measures used to prevent dusting also are effective in protecting the groundwater. Chemical binders reduce the amount of water needed for dust control, which minimizes the potential for leachate generation. Proper compaction is essential as it not only facilitates cell construction and minimizes dusting, but also promotes surface water runoff by minimizing infiltration and cracking due to settlement. Ground and surface waters are monitored to allow for early detection of potential groundwater contamination. (Baker-IVI)

EFFECT OF RAIN WATERS ON LEAD LEVEL IN THE VISTULA IN THE REGION OF CRACOW AGGLOMERATION,

Instytut (Poland). Ksztaltowania Srodowiska, Krakow

For primary bibliographic entry see Field 5C. W85-00230

BUMPER CROP YIELDS GROWING PROB-

SAI Comsystems Corp., Eureka, CA. L. McWilliams.

Environment, Vol. 26, No. 4, p 25-33, May, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Agricultural chemicals, *Wisconsin, Aldicarb, Legislation, Water managment, Insecticides, Fertilizers, Leaching, Soil properties.

While agricultural chemicals have helped to set new crop production standards, they sometimes have combined to pollute groundwater and endanger the health of people, livestock, and other animals. Wisconsin's Central Sands region is an example of an area that has reaped the rewards of modern agricultural practices at the expense of modern agricultural practices at the expense of water quality. The Central Sand's susceptibility to groundwater pollution began thousands of years ago when glaciers retreated northward, depositing sandy, loamy soils in thin layers on top of igneous and metamorphic bedrock. The adverse environmental and economic consequences of over-irrigaand metamorphic bedrock. The adverse environ-mental and economic consequences of over-irriga-tion or excessive precipitation on sandy soils is known. One problem is the presence of insecticides and other agricultural chemicals in the groundwater. News of aldicarb in Wisconsin groundwater came too late for action during the 1981 growing season. Subsequent changes can make such an oc-currence less likely in the future. The outlook for nitrates is not as good Nonpoint source pollution. mitrates is not as good. Nonpoint source pollution is ubiquitous. There are three avenues toward the goal of groundwater free of pollution: federal, state, and local or citizen action. Federal action state, and local or citizen action. Federal action could include legislation protecting groundwater, incentives to states that voluntarily implement groundwater management, or programs that would aid innovative farmers in implementing practices that prevent groundwater pollution. At the local level, even if laws are passed, it will take time to get meaningful enforcement. The forcefulness of national environmental and conservation groups cannot be ruled out in this issue of great concern. (Baker-IVI)

PERMIT FEES FOR NEW JERSEY'S SURFACE AND GROUNDWATER DISCHARGERS, New Jersey Dept. of Environmental Protection,

For primary nary bibliographic entry see Field 6E.

UNDERGROUND TANKS CONTAMINATE GROUNDWATER,

For primary bibliographic entry see Field 5B. W85-00287

DEGRADATION OF PHENOLIC CONTAMI-NANTS IN GROUND WATER BY ANAEROBIC BACTERIA: ST. LOUIS PARK, MINNESOTA, Geological Survey, Menlo Park, CA. For primary bibliographic entry see Field 5D. W85-00348

6. WATER RESOURCES **PLANNING**

6A. Techniques Of Planning

COST AND PRECISION IN A STREAM SAMPLING PROGRAM,

Montana Univ., Missoula. Dept. of Zoology. A. L. Sheldon.

Hydrobiologia, Vol. 111, No. 2, p 147-152, April, 1984. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Costs, *Sampling, *Streams, *Precision, Planning, Research.

The total cost of sampling is the sum of fixed and variable (incremental) components. Attainable sample size and precision are constrained by total budgeted cost and the relative and absolute magnibudgeted cost and the relative and absolute magnitudes of the components. Nomograms relating fixed, variable and total costs to sample size and precision are presented for use in research planning. Preliminary estimates of cost allow one to estimate attainable precision while knowledge of cost components and desired precision specify the total budget. Time costs for a survey of a Montana stream were dominated by fixed costs and the laboratory component of variable costs while variable field costs were small. Cost reductions are always worthwhile. Cost reduction in survey sampling permits large increases in precision while pling permits large increases in precision while reducing variable costs in research sampling have more effect on total cost than on precision. (Moore-IVI) W85-00420

PROBABILISTIC METHOD OF OPTIMIZING SURVEYS WHEN DESIGNING HYDRAULIC STRUCTURES,

F. G. Gaziev.

Hydrotechnical Construction, Vol. 16, No. 6, p 309-312, June, 1982. 3 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitetl'stvo, No. 6, p 19-21, June, 1982.

Descriptors: *Decision making, *Surveys, Design criteria, Systems analysis, Optimization.

The process of designing a hydraulic structure is imagined as consisting of these main stages: surveys, including an engineering-geological survey of the site, geophysical and geotechnical investigations, construction of engineering-geological models; formation of an idea about the character models; formation of an idea about the character and layout of the future structure; construction of a geomechanical model serving as the basis for mathematical and physical modeling; design, calculations and physical modeling; and parametric analysis and establishment of the most important factors determining the design. The use of such a cyclic process, surveys-models-designing-parametric analysis-surveys, makes it possible to obtain the optimal value from the surveys, the necessary accuracy and detail. (Baker-IVI) W85-00467

Group 6A-Techniques Of Planning

DETERMINATION OF THE FIRM YIELD OF A SYSTEM OF RESERVOIRS FOR WATER SUPPLY, A. L. Velikanov, and V. I. Klepov. Hydrotechnical Construction, Vol. 17, No. 9, p 439-443, September, 1983. 1 Fig. 2 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, n.15,18, Sentember, 1983. No. 9, p 15-18, September, 1983.

Descriptors: *Reservoir yield, *Model studies, *Water supply development, *Moscow, *USSR, Simulation, Storage reservoirs, Reservoir operation, Water quantity management.

simulation, Storage reservoirs, Reservoir operations, Water quantity management.

The city of Moscow and adjacent areas are currently supplied with water from the Volga, Vazuza, and Moscow rivers. The system has grown and now consists of eight reservoirs, four of which are located in the basin of the Moscow River and the other four are located in the basin of the upper course of the Volga River. The increase of water consumption and the increase of the requirements imposed on nature-conservation flooding releases inevitably lead to an increase of the water yield of the system. When developing the reservoir management regulations it is necessary to be guided by certain management quality criteria, and these criteria should take into account the real possibility and form of predicting the inflow of water to the reservoirs. When planning reservoirs for water supply the design probability is assigned on the basis of standards. Indices such as the volume of water delivered to the user, the relative number of uninterrupted periods, or the relative number of uninterrupted periods of the acceptable help in developing management regulations, estimating the yield of a water management system, and in determining the indices of its reliability. The use of simulation modeling methods for determining the properties of a system of reservoirs makes it possible to overcome the barrier of the large dimensionality of the problem of optimal control of water management systems. (Baker-IVI)

6B. Evaluation Process

NATIONAL WATER SUMMARY 1983- HY-DROLOGIC EVENTS AND ISSUES, Geological Survey, Reston, VA. Water Resources

Div. Available from Supt. of Documents, GPO, Washington, D.C. 20402. USGS Water-Supply Paper 2250, 1984. 243 p. 11 Fig. 9 Tab, 66 Maps.

Descriptors: *National Water Sums State interrelationships, State jurisdiction, Hydrologic cycle, *Water policy, *State policies, Water management, Institutional constraints, Water availability, Water quality, Hydrologic hazards, Land

The 1983 National Water Summary reviews cur-rent hydrological conditions and recent events in the United States and provides a broad overview reat hydrological conditions and recent events in the United States and provides a broad overview of the hydrologic issues facing the nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the western Pacific Islands under the jurisdiction of the United States. States were chosen as the basis for describing water issues because the country's water resources are managed and controlled, for the most part, by State governments. The State water-issue summaries were prepared by U.S. Geological Survey personnel in each of the states and are based on discussions with more than 130 State and local organizations, reviews of recently published information, and knowledge of water conditions acquired in the course of U.S. Geological Survey studies. The State water-issue summaries identify concerns expressed by State and local water-management officials. In some cases, they also illustrate the variety of actions that are being taken to resolve the issues. Major issues described in this report include (1) the short-term vulnerability of surface-water supplies and shallow ground-water supplies to drought; (2) concerns about the reliabil-

ity of water supplies as competition for water increases; (3) declining groundwater levels; (4) control of surface-water pollution, especially non-point sources of pollution; (5) contamination of ground-water supplies and the mitigation of existing sources of pollution, such as hazardous-waste aites; (6) the potential effects of acidic precipitation; (7) chronic problems of flooding; (8) the impacts of resource development, such as coal mining and low-head hydropower, on water resources; and (9) the development of water allocation and reallocation procedures. Hydrologic perspectives on these issues are discussed under the heading 'Water availability'; 'Water Quality'; 'Hydrologic hazards and land use'; and 'Institutional and management'. (USGS)

ESTIMATED USE OF WATER IN THE UNITED STATES IN 1980, Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 6D. W85-00042

WATER IN AMERICA 1983, A REPORT BY THE OFFICE OF WATER POLICY, DEPART-MENT OF THE INTERIOR.

MENT OF THE INTERIOR.
Department of the Interior, Washington, DC.
Office of Water Policy.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. OWP Report, (1984). 18 p, 5
Fig. 1 Tab.

Descriptors: *Water policy, *River management, *Interstate water conflicts, *Indian water rights, *Water project development, *Acid rain, *Salinity, Water quality.

This is a supplemental report to accompany the National Water Summary 1983 (USGS Water Supply Paper 2250). That report provides a detailed look at water resources conditions throughout the United States. Several policy issues emerge from this review of regional and State data relating to the availability and quality of our water supply and the impact of natural hazards such as drought and flooding. Their analysis explores the kinds of problems posed by underlying hydrologic conditions, the changing roles of Federal, State and local authorities, and promising trends in solutions developing at each level of government. In this report six policy issues have been chosen for special attention: (1) Improving River Management; (2) Interstate Water Conflicts; (3) Water Project Development; (4) Indian Water Claims; and (5 and 6) Water Quality: Acid Rain and Salinity. W35-00057 out the United States. Several policy issues em

WATER RESOURCES APPRAISAL OF THE COLLEGE OF THE VIRGIN ISLANDS AREA, ST. THOMAS,

Caribbean Res earch Inst., St. Thomas, VI. Carlocal Research Inst., 51. Thomas, vi. O. Ajayi, and F. Gomez-Gomez.
Technical Report No. 11, September 1983. 70 p, 12
Fig. 10 Tab, 23 Ref. OWRT Project No. A-009-VI
(2), Contract/Grant No. 14-34-0001-2150.

Descriptors: *Water supply management, *Water harvesting, Groundwater development, *Conjunc-tive use, Optimum development plans, *Virgin Is-lands, *St. Thomas, Cost effectiveness, *Water supply augmentation

The St. Thomas campus of the College of the Virgin Islands faces water management problems typical of the Virgin Islands. Lack of detailed accounting in the water supply and distribution system makes optimal decision-making for water management at the College difficult to realize. The College has also had to ration water in the past. However, the College has aquifers which can be exploited under better management to yield enough water, in conjunction with the rainwater harvesting system, to satisfy its water needs in an harvesting system. enough water, in conjunction with the rainwater harvesting system, to satisfy its water needs in an average rainfall year. The College will face increasing water bills if dependency on public supply continues. Water rates have jumped from \$6.50/Kgal to \$17.50/Kgal in less than four years and are expected to go higher. Harvested rainwater and groundwater represent least cost alternatives of water supply to the College. Emphasis should be on conservation and full utilization of all available roof areas and storage capacity which are presently under-utilized to reduce the overall costs of providing water to the College. W85-00066

PREDICTION OF ECONOMIC POTENTIAL FOR IRRIGATION USING A GROUND-WATER MODEL, Oklahoma State Univ., Stillwater. Dept. of Geolo-

gy. For primary bibliographic entry see Field 4B. W85-00336

PROSPECT RISK ANALYSIS APPLIED TO GROUND-WATER RESERVOIR EVALUA-

G H Davis Ground Water, Vol. 20, No. 6, p 657-662, November-December, 1982. 2 Fig. 1 Tab, 12 Ref.

escriptors: *Groundwater storage, *Water yield, *Assessments, *Storage capacity, Aquifer characteristics, Groundwater hydrology, Reservoirs, Evaluation, Risks, Monte Carlo method.

A method is proposed for predevelopment assessments of the potential yield of groundwater reservoirs. A systematic assessment of aquifer parameters leads to estimates of groundwater storage capacity and the geologic risks that may affect those estimates. Area of reservoir, average saturations of the property of the statement of the property of the ed thickness of aquifers to a limit of economic dewatering, and average specific yield, all arrived dewatering, and average specific yield, all arrived at through a Delphi procedure are combined in a Monte Carlo simulation to yield an unrisked product at several probability levels. Marginal probabilities are assigned to each parameter and combined in a further Monte Carlo simulation to yield a series of risk estimates. The results are expressed in a table and a cumulative probability curve of croundwater storage capacity, that can provide a a table and a cumulative probability curve of groundwater storage capacity that can provide a basis for economic modeling. When applied to the estimation of fresh groundwater resources of a specific hydrogeologic unit the following steps would be taken: assemble all available hydrogeolo-gic data on the groundwater reservoir or subdivi-sions thereof; summarize the information following a standard format of tables, sections, and maps; quantify the data to the feasible degree including extent, thickness and character of known aquifers extent, thickness and character of known aquifers and interbedded materials, mode of occurrence of ground water, porosity, permeability, and storati-vity of aquifers, and information on recharge and vity of aquifers, and information on recharge and discharge; convene a panel of hydrogeologic experts to review the data for a given reservoir. Each expert is polled as to his subjective estimate of a low storage capacity corresponding to a 95% chance that at least that much storage capacity is available, a high storage capacity corresponding to a 5% chance that at least that much storage capacity is available, a model value which the expert associates with the highest probability of that storage capacity occurring, and a mean value calculated by summing the others and dividing by three. The results are then reviewed by the group. The subjective estimates of the experts are combined in a Monte Carlo procedure to arrive at a set of probabilistic estimates of the storage capacity of probabilistic estimates of the storage capacit the reservoir under consideration. (Baker-IVI)

QUANTITATIVE MODEL TO PREDICT A SAFE YIELD FOR WELL FIELDS IN KUFRA AND SARIR BASINS, LIBYA, Ohio Univ., Athens. Dept. of Geological Sciences.

Ground Water, Vol. 21, No. 1, p 58-66, January-February, 1983. 7 Fig. 1 Tab, 29 Ref.

Descriptors: *Groundwater management, *Wells, *Predicting, *Libya, *Kufra Basin, *Sarir Basin, Basins, Water resources development, Irrigation,

Using the available water level data of the Kufra and Sarir basins, a steady state model was con-

Water Demand—Group 6D

structed, and regional transmissivities were determined for the two basins. The best match with the actual water level data indicated a discharge of actual water level data indicated a discharge of about 80 cu m/s. This appears to be a reasonable discharge on the basis of estimated underflow of 40 cu m/s from Libya, and about 29 cu m/s is discharged from Libyan oases. In addition to the existing KSP, KPP, South and North Sarir, and Jalo well fields, nine more well fields are proposed in the Kufra and Sarir basins. These well fields are planned to pump a total quantity of 120 cu m/s. The simulation which was performed indicated that sufficient drawdown was available to last at least 50 years. (Baker-IVI) W85-00358

EVALUATION OF THE EFFECTIVENESS OF MEASURES TO SHORTEN THE CONSTRUCTION TIME OF MASS CONCRETE STRUCTURES OF HYDROELECTRIC STATIONS, B. E. Kazantsev, and V. I. Teleshev. Hydrotechnical Construction, Vol. 16, No. 7, p 395-400, July, 1983. 2 Fig. 2 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 26-29, July, 1982.

Descriptors: *Concrete, *Decision making, Hydraulic engineering, Construction, Optimization, Systems analysis.

The most important criterion of the optimization of a decision with respect to the technology and organization of constructing structures at hydrostations is the time necessary to complete the various tasks needed. The effectiveness of technological and oganizational decisions aimed at increasing the rate of placing concrete in the main structures and, consequently, at shortening the construction time on the whole, should be examined carefully. An index is presented which permits a numerical evaluation and comparison of the effectiveness of introducing various organizational and technological measures and singles out the most effectiveness. The example given uses the proposed criterious contractions of the proposed criterious contractions are supposed to the most effectiveness. cal measures and singles out the most effective ones. The example given uses the proposed crite-rion and shows its clarity and practical applicabi-ity for evaluating the effectiveness of specific measures. Since in principle it is possible that one measure can prove to be optimal with respect to an index, an increase of height above this optimal value not only will not increase the rate of placing concrete in the structure but will even lead to a decrease. (Baker-IVT)

ARCHITECTURE OF FOREIGN HYDROELE-TRIC STATIONS, V. N. Vaksman, and E. A. Pershanin. Hydrotechnical Construction, Vol. 17, No. 10, p 16-20, October, 1983. 8 Fig. Translated from Gi-drotekhnicheskoe Stroitel'stvo, No. 10, p 16-20, October, 1983.

Descriptors: *Hydroelectric plants, *Developing countries, *Architecture, *Egypt, *Syria, *Tunisia, *Morocco, Hydraulic structures, Construction, Design criteria, Planning.

Design criteria, Planning.

When developing the architecture of hydraulic structures for new power stations in developing countries, it is necessary to take into account not only the local climatic conditions and established national traditions, but also those social transformations which are characteristic for the majority of them. The depth of the approach of architects to a general architectural solution is characterized by its effect on the engineering-technological layout of the powerhouse of the hydroelectric station. It is noted that when designing generator rooms not combined with dams of powerhouses, a unique engineering tradition has become established in which the structural members of the supporting framework of the powerhouse itself are used for technological servicing of the units by crane equipment during their installation or repair. Several architectural approaches to specific dams are discussed including the Aswan High Dam on the Nile River in Egypt, the Tabqa hydrostation on the Euphrates River in Syria, a hydrostation on the Kasseb River in Tunisia, and the Mansour Eddahbi hydroelectric station in Morocco. (Baker-IVI)

HYDROPOWER UTILIZATION SCHEME OF THE EUPHRATES RIVER IN SYRIA, For primary bibliographic entry see Field 4A For primary W85-00504

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST-BENEFIT ANALYSIS OF WETLAND DRAINAGE, Leeds Univ. (England). School of Economic Stud-

For primary bibliographic entry see Field 4A. W85-00278

6D. Water Demand

ESTIMATED USE OF WATER IN THE UNITED STATES IN 1980, Geological Survey, Reston, VA. Water Resources

Div. W. B. Solley, E. B. Chase, and W. B. Mann, IV. Available from Distr. Br., USGS, 604 S. Pickett St., Alex., Va. 22304. U.S. Geological Survey Circular 1001, 1983. 56 p, 13 Fig. 22 Tab, 119 Ref.

Descriptors: *Estimated U.S. water use, *Water use, Water use efficiency, *Consumptive use, Water demand, *Estimating, Irrigation water, Municipal water, Domestic water, Industrial water, Water reuse, Conjunctive use, United States.

micipal water, Domestic water, Industrial water, Water reuse, Conjunctive use, United States.

Water use in the United States in 1980 was estimated to be an average of 450 bgd (billion gallons per day) of fresh and saline water for offstream uses an 8-percent increase from the 1975 estimate and a 22-percent increase from the 1975 estimate and a 22-percent increase from the 1970 estimate. Average per capita use for all offstream uses use 2,000 gpd (gallons per day) of fresh and saline water, and 1,600 gpd of fresh water; this represents a slight increase since 1975. Offstream uses include (1) public supply (domestic, public, commercial, and industrial uses), (2) rural (domestic and livestock uses), (3) irrigation, and (4) self-supplied industrial uses (including thermoelectric power). From 1975 to 1980, public supply use increased 15 percent to 34 bgd, rural use increased 14 percent to 5.6 bgd, and self-supplied industrial use increased 8 percent to 260 bgd. Within the industrial category, thermoelectric power generation increased 9 percent to 210 bgd, whereas other self-supplied industrial uses remained approximately constant at 45 bgd. Total fresh water consumed- that part of water withdrawn that is no longer available for subsequent use- by these offstream uses increased 7 percent to 100 bgd, with irrigation accounting for the largest part of water consumed, estimated at 83 bgd. Estimates of withdrawals increased 9 percent to 360 bgd. Total saline-water withdrawals increased 9 percent to 360 bgd. Total saline-water withdrawals increased by about 2 bgd to 72 bgd, of which 71 bgd was saline surface water. Reclaimed sewage amounted to about 0.5 bgd in 1980, an 11-percent decrease from 1975 to 1980, total groundwater withdrawals increased from 1975 water used for hydroelectric power generation, an instream use, remained unchanged from 1975 to 1980 indicate a general slackening in the rate of increase of total withdrawls in comparison to the period 1965 to 1970. (USGS) W85-00042 period 1965 to 1970. (USGS) W85-00042

RESOURCES OF THE TUG HILL REGION. State Univ. of New York Coll. of Environmental

Science univ. or New York Coll. of Environmental Science and Forestry, Syracuse. A. Eschner, J. Osinski, D. Howe, and S. Shupe. Report prepared for the Temporary State Commis-sion on Tug Hill, February 1984. p 86-119, 5 Fig, 14 Tab, 28 Ref.

Descriptors: *Precipitation, *Aquifers, *Rainfall, *Snow accumulation, *Annual distribution.

*Water quality, Regional development, Surface water, Stream gages, Water sampling, Groundwater availability, Groundwater quality, *New York, Tug Hill regi

Few areas in New York State receive more precipitation than the Tug Hill region. The average annual precipitation for the study area during the period 1963-1974 was 45.18 inches, with some portions receiving in excess of 54 inches. Precipitation is fairly evenly distributed throughout the year; average monthly totals range from 7.2 percent (March) to 10.8 percent (November) of the annual value. The annual snow accumulation ultimately provides most of the region's usable water in surface streams or groundwater aquifers. Municipal and industrial pollution, as well as sediment and agricultural pollution, occur mostly on the fringes of the region. Relatively high quality groundwater is available throughout the region. In a large portion of the area, its yield is very low; however, in some places, such as the area around Camden, aquifers have enormous capacity and potential yield. Use of water is relatively low when compared to the total annual amount available. An expanded regional program of streamgaging is recommended, including reactivation of the recently inactive Deer River gage, planned in conjunction with the development of explicit regional resource management objectives. Also recommended is a comprehensive groundwater survey, primarily in Jefferson and Lewis Counties where information is limited; a design sampling network and schedule to better define the water quality of the region's water bodies and aquifers; and additional anow survey courses. (Garrison-Ommiplan)

INVESTIGATION OF THE CARRYING CAPACITY OF THE MONOCACY RIVER AS A
SCENIC AND RECREATIONAL RESOURCE,
VOLUME III. THE MONOCACY RIVERANALYSIS OF EXISTING SITUATION AND
RECOMMENDATIONS FOR PROTECTING
THE RIVER RESOURCE,
Marghet Lights College Park of Recognitions.

Maryland Univ., College Park. Dept. of Recrea-

F. R. Kuss, and K. Schaub.

F. R. Kuss, and K. Schaub.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB84 190222,
Price codes: A08 in paper copy, A01 in microfiche.

Maryland Water Resources Research Center Publication No. 67, December 1982. 141 p. 5 Fig. 30
Tab, 21 Ref. 1 Append. OWRT Project No. A041-MD (3), Contract/Grant No. 14-34-0001-2122.

Descriptors: River basin development, River systems, Rivers, Watersheds, *Recreation demand, Boating, Fishing, Swimming, Camping, Campistes, Riparian rights, Management planning, Water quality, Wildlife habitats, *Monocacy River, *Maryland, Piedmont, *Scenic rivers, *Carrying

The Monocacy River Valley of central Maryland is recognized as a significant cultural and historic resource of national importance. Designated as a scenic river by the state in 1977, this study describes the existing physical, biological and cultural resources of the river and valley; how different segments of the public view the system and its preservations; makes an assessment of future demands for river-oriented recreation in the counties through which the river courses, and recommends mands for river-oriented recreation in the counties through which the river courses, and recommends a conceptual plan for the preservation of the river corridor. In Volume III the demand for and supply of recreational facilities in the three Maryland counties which encompass the Monocacy River Valley are analyzed. Based on trends in reported Valley are analyzed. Based on trends in reported participation rates and population projections to 1990, canoeing, hiking, and nature walks will show net increases in demand up to 1990 in the three counties. Demand for camping, fishing, and swimming facilities will plateau or show modest growth during the period. To facilitate future planning efforts which utilize existing institutional means for protecting the river resource and surrounding lands; to encourage the cooperation of the ripartian land-owners in maintaining the scenic quality of the corridor; to initiate area-wide program planning to improve water-quality, and to provide im-

Field 6-WATER RESOURCES PLANNING

Group 6D-Water Demand

proved wildlife habitat in the corridor area, a management plan for the Monocacy River is pro-posed. W85-00073

IMPACT OF LAKE MICHIGAN ALLOCA-TIONS ON THE CAMBRIAN-ORDOVICIAN AQUIFER SYSTEM,

Illinois State Water Survey Div., Champaign. For primary bibliographic entry see Field 4B. W85-00343

6E. Water Law and Institutions

NATIONAL WATER SUMMARY 1983- HY-DROLOGIC EVENTS AND ISSUES. Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 6B. W85-00035

WATER SUPPLY SOURCE PROTECTION RULES AND REGULATIONS PROJECT,

State Univ. of New York Coll. of Enviror Science and Forestry, Syracuse. R. D. Hennigan. Final Report, March 1981. 178 p, 8 Fig, 22 Tab.

Descriptors: *Administrative regulations, *Administrative agencies, *Water supply systems, *Legal aspects, *Water policy, *Public policy, Public health, Policy making, Competing use, Potential water supply, Contamination, *New York.

A comprehensive review of the New York State public water supply rules and regulations program was conducted beginning with notification of 4,000 interested persons in the public sector. The review covered program development and administration, the nature and extent of water resources utilization covered program development and administration, the nature and extent of water resources utilization for public water supply purposes, related environmental protection programs, current issues and possible contaminants. Among the recommendations are that the State Department of Health should enact rules and regulations for all public water supply sources in cooperation with the water supply sources in cooperation with the water supply owners and the local health department. This would help produce an effective water supply source protection program. In addition, county health agencies and district health agencies should be given the responsibility for regular and special inspections so they may be of assistance to water supply systems serving fewer than 5,000 people. The county or district health agency should make annual inspections of the watersheds of larger systems, and should be responsibility for enforcing voluntary compliance. The responsibility for enforcement of involuntary or forced compliance should be transferred from local boards of health to regional health offices. The report also recommends various amendments to the public health law The study found that there is no provirecommends various amendments to the public health law. The study found that there is no provision in law to protect surface or ground water resources from contamination. (Garrison-Omniplan) W85-00046

WATER IN AMERICA 1983, A REPORT BY THE OFFICE OF WATER POLICY, DEPART-MENT OF THE INTERIOR

Department of the Interior, Washington, DC. Office of Water Policy.
For primary bibliographic entry see Field 6B. W85-00057.

REDUCING THE FEDERAL ROLE IN WET-

LANDS PROTECTION, P. Wakefield. Environment, Vol. 24, No. 10, p 6-13, 30-33, December, 1982. 8 Fig. 98 Ref.

Descriptors: *Wetlands, *Regulations, *Federal jurisdiction, State jurisdiction, Legislation, Decision making, Planning, Policy, Resources management.

A growing awareness that wetlands are both eco-logical and economic resources has encouraged a

stronger commitment to wetlands management through state and federal legislation and regulation. The major federal provision for wetlands protection, Section 404 of the Clean Water Act, has been put high on the priority list by the Presidential Task Force on Regulatory Relief. The debate currently reflects the larger question of the proper role of the federal government in wetlands protection. The National Wetlands Inventory protection. The National Wettands inventory Project, directed by the Fish and Wildlife Service (FWS) was first established in 1974 and expanded by the 1977 Amendments to the Clean Water Act to provide comprehensive, scientifically deterto provide comprehensive, scientifically determined data about the extent and characteristics of the nation's wetlands. Although a preliminary inventory report calls for further study by an interdisciplinary team of scientists to determine the causes and implications of the trends in wetlands gains and losses, the potential importance of the inventory for regulatory use is clear. New proposals designed to reduce the regulatory burdens created by 404 include: reducing 404 jurisdiction to traditionally navigable waters, reduce permit processing time; transfer more permitting authority to the states; expand the use of general permits; and reduce conflicting or overlapping policies and responsibilities. The Clean Water Act is itself due for Congressional reauthorization. Even so, any slow-downs in the flow of regulatory changes are likely downs in the flow of regulatory changes are likely to be only temporary. (Baker-IVI)

COLORADO RIVER, RIVER OF CONTROVER-

SY, Center for Natural Resource Studies, Berkeley,

R. Coats. Environment, Vol. 26, No. 2, p 7-13, 36-39, March, 1984. 10 Fig. 22 Ref.

Descriptors: *Management, *Colorado River, *Legal aspects, Agriculture, Fishing, Wildlife, Salinity, Decision making, Planning, Legislation, Regulation, Water supply development.

The Colorado River Working Symposium: Management Options for the Future was convened for the purpose of stimulating, in a neutral forum, freewheeling discussions of the severity of Colorado River problems and of possible solutions. The cornerstone of the body of the law known as the Law of the River is the Colorado River Compact. Law of the River is the Colorado River Compact. The upper basin states began in 1920 to push for a compact that would secure a water supply for their own development. Provisions and the lack of provisions in this compact are discussed. Through the years conflicts with the states of Arizona and Cailfornia as well as international conflicts with Mexico arose. Problems with salinity control, legal and institutional obstacles to diverting and utilizing saline groundwater, relocation of industrial and municipal outfalls, Indian water rights, wilderness values and instream uses, agricultural vs other uses, and efficiency vs equity are discussed. (Baker-IVI) and efficiency vs equity are discussed. (Baker-IVI) W85-00276

PERMIT FEES FOR NEW JERSEY'S SURFACE AND GROUNDWATER DISCHARGERS, New Jersey Dept. of Environm

P. R. Yeany. Environmental Forum, Vol. 2, No. 9, p 21-25, January, 1984. 3 Tab.

Descriptors: *Groundwater management, *Legis-lation, *Permits, *New Jersey, Regulations, Groundwater pollution, Landfills, Waste disposal.

Nearly two years ago the New Jersey Dept. of Environmental Protection adopted regulations establishing the Pollutant Discharge Elimination System for the state (NJPDES). Concerning groundwater, the NJPDES Regulations established a system of permits for a variety of pollution sources including sanitary landfills, land application of waste sludges and septage, underground injection wells, surface impoundments, infiltration-percolation lagoons, and community septic systems. Permit fees were to be used to fund the program. Not only do the fees support the pro-

gram, as they are designed in relation to environmental factors, the fees encourage reduction of environmental harm caused by the discharges. The NJPDES Surface Water Budget is presented, along with a breakdown by discharge category. Examples are offered of compliance sampling in spections listed by permit number, supplying the name of the facility and giving the results of the sampling study. Various issues have been raised in response to the fee schedules. (Baker-IVI) W85-00281

INADVERTENT INCOME REDISTRIBUTION EFFECTS OF STATE WATER DEVELOPMENT FINANCING,

Utah Water Research Lab., Logan. D. H. Hoggan, J. M. Bagley, and K. R. Kimball. Growth and Change, Vol. 14, No. 4, p 32-36, October, 1983. 7 Ref.

Descriptors: *Water resources development, *Financing, *Income distribution, *Utah, Government supports, Loans, Social aspects.

Governmental financing of water development projects typically has income redistribution objectives. Income transfers are accomplished through direct grants between units and levels of government, interest foregone by a higher level of government, sharing of certain costs among units and levels, or other forms of direct and indirect subsidy ultimately derived from general tax revenues. Examples of inadvertent redistribution are offered, ampies of inancirent redistribution are offered, using three programs of state financial assistance for water projects in Utah. Utah's Revolving Construction Fund was created in 1947 and is used mainly to finance irrigation projects such as the construction of small reservoirs, the lining of constant introduction of small reservoirs, the lining of construction of small reservoirs, the lining of canals, installation of pipeline conveyance systems, and the repair of existing irrigation facilities. The Cities Water Loan Fund, a second revolving fund, was created in 1975 in response to two problems: the need of fast growing communities in energy resource development areas to expand and improve their potable water supply and, the need of many small communities to improve their water systems to meet increasingly stringent health standards. The Water Resources Conservation and Development Fund, a third fund, was created in 1978 in the wate of an 18-month drought and a federal in the wake of an 18-month drought and a federal water policy reevaluation and subsequent project hit list that created some concern among western water officials. To initiate and sustain any governmental program requires social justification. Frequent reevaluation is needed to guarantee that outcomes remain congruent with the intended social purpose. (Baker-IVI)
W85-00367

6F. Nonstructural Alternatives

FLOODPLAIN MANAGEMENT HANDBOOK. Flood Loss Reduction Associates, Palo Alto, CA. Available from Supt. of Documents, GPO, Washington, D.C. 20402. Water Resources Council Report, Washington, D.C., September 1981. 89 p, 19 Fig. 3 Tab, 30 Ref.

Descriptors: *Flood plain management, *Handbooks, Flood plains, *Flood protection, *Flood loss mitigation, Flood plain zoning, Nonstructural alternatives, Technical assistance, Financial assistance,

A concerted effort is under way to stem the growth of flood losses. This handbook summarizes the problem and points out what can be done. It is intended to help local officials, public interest groups and concerned citizens in assessing the problems in their area and initiating appropriate and effective management of the floodplain. The handbook treats both riverine and coastal floodnandook treats out invertie and coasta hood-plains. It describes a full range structural and non-structural measures to reduce flood losses and maintain the natural values of the floodplain. The handbook provides step-by-step guidance for de-veloping a floodplain management program. It also identifies the range of technical and financial assist-

Ecologic Impact Of Water Development—Group 6G

ance available for preparing and implementing

IMPROVEMENT OF WATER ACCOUNTING

IMPROVEMENT OF WATER ACCOUNTING AT PUMPING STATIONS, Yu. K. Zhukov, and I. S. Sarzhinskii. Hydrotechnical Construction, Vol. 16, No. 5, p 289-291, November, 1982. 4 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 48-49,

Descriptors: *Pumping plants, *Water measurement, *Water storage, Accounting, Water shortage, Uzbekistan, Water distribution, Metering.

Due to the shortage of irrigation water in Uzbekistan, improving the system of accounting and distributing water resources is becoming more and more urgent. Reliable operation of water accounting devices at pumping stations is vital to this task.

The simplest, most reliable, and at the same time highly accurate method of water accounting is the variable difference method in which the difference variable difference method in which the difference of piezometric heads is measured at two selected points of the walls of the pressure conduit. This method is most effective when the conduits have elbows. When designing pumping stations, it is necessary to specify in the design pressure leads for head flowmeters on elbows of pressure pipes and segment orifice plates in the cases where there are no elbows. It is necessary beforehand to provide for and assemble devices facilitating the measurement of discharges when testing pumps and calibrating flowmeters. (Baker-IVI)

6G. Ecologic Impact Of Water Development

PROJECTED EFFECTS OF PROPOSED CHLO-RIDE-CONTROL PROJECTS ON SHALLOW GROUND WATER-PRELIMINARY RESULTS FOR THE WICHITA RIVER BASIN, TEXAS, Geological Survey, Austin, TX. Water Resources

For primary bibliographic entry see Field 5G. W85-00026

PHEASANT (PHASIANUS COLCHICUS) HABI-TAT SUTTABILITY MODEL, Washington State Univ., Pullman. Dept. of Agri-cultural Economics.

cultural Economics.
S. C. Matulich, J. E. Hanson, and I. Lines.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB84 190438,
Price codes: A05 in paper copy, A01 in microfiche.
Washington Water Research Center Report 55,
November 1983. 83 p, 33 Fig, 58 Ref. OWRT
Project No. B-086-WASH (2), Contract/Grant
No. 14-34-0001-9160.

Descriptors: *Habitat suitability, Index, Environmental effects, *Wildlife management, *Pheasant, *Washington, Literature review, Model studies, Columbia Basin Irrigation Project.

A breeding and winter habitat suitability index (HSI) model is developed for the ring-necked pheasant (Phasianus colchicus). The HSI model framework follows the Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service. Overall habitat suitability is defined in terms of seasonal habitat, species life requisites and the environmental attributes that quantify each cover type's notential for satisfying specific life. the environmental attributes that quantify each cover type's potential for satisfying specific life requisites. A review of literature on pheasant habitat requirements is presented, followed by a general year-round HSI model. This general model is then modified to account for habitat characteristics in the East High area of the Columbia Basin Irrigation Project, Washington.

EFFECTS OF URBANIZATION ON PHYSICAL HABITAT FOR TROUT IN STREAMS, Montana State Univ., Bozeman. Dept. of Biology R. J. White, J. D. Wells, and M. E. Peterson.

Available from the National Technical Information Service, Springfield, VA 22161, as PB84 190131, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Report No. 139, Bozeman, October 1983, 48 p, 8 Tab, 6 Fig, 18 Ref, 1 Append. OWRT Project No. A-134-MONT (1), Contract/Grant No. 14-34-001-2128.

Descriptors: *Trout, *Stream, Fisheries, Habitat, *Channel improvement, Fish populations, Bank stabilization, Shoreline cover, Fish management, *Montana, Urban streams, Nonurban streams, Wyoming Habitat Quality Index.

Non-urban were more favorable than urban stream sections as habitat for trout and held more trout. The major habitat difference was amount of instream solid overhead hiding cover. Urban land modifications had created unnaturally straight, narrow channels with high, unstable banks with little of the undercuts and woody debris that provide shelter for fish. Urban and non-urban sections did not differ significantly with respect to water velocity, dissolved nitrate, or amount of pools or water turbulence. Per unit stream length, non-urban sections averaged 34% more trout larger than 20 cm (8 inches) and 74% greater total trout biomass than urban sections. In both urban and than 20 cm (8 inches) and 74% greater total trout biomass than urban sections. In both urban and non-urban areas, trout abundance as kg/ha was generally below the level predicted by the Wyoming Habitat Quality Index (HQI). This could have been due to effects of angling or other uneasured factors, to measurement errors or to inapplicability of the HQI method to the areas studied. There is evidence that altering the HQI method to consider solid overhead hiding cover and pool-turbulence hiding cover as separate variand pool-turbulence hiding cover as separate variant pool-turbulence hiding pool-turbulence hiding pool-turbulence hiding pool-turbulence hiding pool-turbulence hiding pool-turbulence hiding pool-turbulenc and pool-turbulence hiding cover as separate varia-bles rather than as a total cover index will enhance predictiveness. Implications for urban stream fishery management are discussed.

W85-00070

INFLUENCE OF A REDUCTION IN FLOW ON A MOUNTAIN RIVER: THE ASTON (ARIEGE) (INFLUENCE D'UNE REDUCTION DE DEBIT

(INFLUENCE D'UNE REDUCTION DE DEBIT SUR UN TORRENT DE MONTAGNE: L'ASTON (ARIEGE)), Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Res-sources Renouvelables.

E. Chauvet. Annales de Limnologie, Vol. 19, No. 1, p 45-49, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Aston, *Ariege, *France, *Dam effects, *Mountain streams, *Trout, Environmental effects, Population dynamics, Species diversity, Chironomids, Spawning, Immature growth stages.

Although a number of dams exist in the Pyrenees Mountains, little is known about the ecological effects of such structures on mountain streams. In 1956, a dam was constructed on the Aston, a branch of the Ariege at Riete. The reservoir has an area of 75,000 sq m and a capacity of 800,000 cu m. The flow reduction downstream of the dam (100 l/s minimum instead of 2 cu m/s on the average s minimum instead of 2 cu m/s on the average upstream) has not produced any notable change in the chemical properties of the water. There has been a degradation in the biological diversity of the benthic fauna downstream of the dam, with a predominance of chironomids. The trout population was reduced by 10% and its biomass by 25% downstream of the dam. The reduction in current velocity and the surface area of the stream are probably responsible for this decrease. The trout populations are unbalanced, with a large proportion of old fish. The area immediately downstream from the dam is subject to sudden variations in flow and to turbidity during discharge, and so is unfavorable for reproduction and young fish. (Moore-IVI) (Moore-IVI) W85-00091

UPSTREAM MIGRATION BY YOUNG PIG-MENTED FRESHWATER EELS (ANGUILA AUSTRALIS AUSTRALIS RICHARDSON) IN TASMANIA

Tasmanian Inland Fisheries Commission, Hobart (Australia).

Australian Journal of Marine and Freshwater Research, Vol. 35, No. 1, p 61-73, 1984. 6 Fig. 1 Tab, 22 Ref.

Descriptors: *Fish behavior, *Hydroelectric plants, *Migration, *Eels, *Tasmania, *Australia, Seasonal variation, Temperature effects, Turbines, Solar radiation, Fisheries

In view of the importance of elver migrations, serving to replenish eel stocks in inland waterways, the Tasmanian Inland Fisheries Commission has undertaken a pilot scheme to transfer elvers up-stream at major hydroelectric dams that provide an impass to upstream eel migrations. During late spring and summer, upstream migrations by young pigmented freshwater eels can be seen at stream barriers in Tasmania. The elver runs at two major hydroelectric dams, Trevallyn and Meadowba were sampled regularly during the period 1977-1981 and migrations at a number of smaller stream barriers throughout Tasmania were also studied.
Migrating elvers were short-finned eels, A. a australis; only a single specimen of the long-finned eel, A. reinhardtii Steindachner, was recorded. Elvers sampled at inland stream barriers were both larger and older than those found nearer the sea, indicating that eels migrate farther upstream for several years in succession. Eels involved in upstream migration were shorter than 25 cm, having spent up to 10 years in fresh water. Day length, water temperature and river flow all contribute to the initiation and control of elver migration. At Trevallyn Power Station it was apparent that the run of elvers was determined by turbine output rather than by any natural environmental influence. The combined loadings of No. 1 and No. 2 turbines commined roadings of No. 1 and No. 2 turbines have been correlated with the elver catch and it is obvious that the major catches correspond to low flows through the power station tailrace. No clear evidence for any relationship between lunar days and elver runs was noted. The number of elvers involved in annual migrations at major hydroelec-tric dams in Tasmania is substantial: the largest migration occurs at Trevallyn, where between 3,000,000 and 5,000,000 elvers take part each year.

These elvers represent a considerable stocking potential and could be used to expand the local wild eel fishery. (Baker-IVI) W85-00131

MITIGATING EFFECTS OF ARTIFICIAL RIF-FLES AND POOLS ON THE FAUNA OF A CHANNELIZED WARMWATER STREAM, International Joint Commission-United States and

Canada, Columbus, OH. C. J. Edwards, B. L. Griswold, R. H. Tubb, E. C. Weber, and L. C. Woods.

North American Journal of Fisheries Management, Vol. 4, p 194-203, 1984. 8 Fig. 7 Tab, 20 Ref. Department of the Interior Contract 14-16-00080-738.

Descriptors: *Channelization, *Aquatic animals, *Olentangy River, *Ohio, Fish, Invertebrates, Population diversity, Population dynamics, Riffles, Pools, Environmental effects, Sport fishing.

The effect of stream channelization on macroinvertebrates, fish, and the sport fishery was studied in the Olentangy River at Columbus, Ohio. Macroinvertebrate abundance, diversity indices, standing stock in the benthos, and drift were significantly lower in a channelized area than in either a natural area or a channelized area mitigated with artificial area or a channelized area mitigated with artificial riffles and pools. The common groups of fishes found in the Olentangy River included important game species such as sunfishes, crappies, basses, and catfishes. In general these fishes were significantly more abundant in the unchannelized and mitigated areas, whereas nongame fish, fish that are bottom and detrius feeders, predominated in the channelized areas. Composition of the sport fishing catch and catch rates accurately reflected the predominant fish community in each area. (Baker-IVI)

Group 6G-Ecologic Impact Of Water Development

EFFECTS OF INCREASING SNOWPACK ON A SUBALPINE MEADOW IN THE UINTA MOUNTAINS, UTAH, U.S.A., Native Plants, Inc., Salt Lake City, UT. For primary bibliographic entry at W85-00236 ee Field 2C.

IMPACT OF LAND-USE ON THE ACID AND TRACE ELEMENT COMPOSITION OF PRE-CIPITATION IN THE NORTH CENTRAL U.S., Minnesota Univ., Minnespotis. Dept. of Civil and Mining Engineering. For primary bibliographic entry see Field 2K. W85-00243

RIVERS: OUR VANISHING HERITAGE National Audubon Society, Washington, DC. For primary bibliographic entry see Field 4A. W85-00282

EFFECTS OF LONG-TERM ARTIFICIAL FLOODING ON A NORTHERN BOTTOM-LAND HARDWOOD FOREST COMMUNITY, Cornell Univ., Ithaca, NY. Dept. of Natural Re

R. A. Malecki, J. R. Lassoie, E. Rieger, and T.

Forest Science, Vol. 29, No. 3, p 535-544, 1983. 2 Fig. 3 Tab, 20 Ref.

Descriptors: *Water management, *Flooding, *Forests, *New York, *Plant communities, Wild-life habitats, Bottomlands, Trees, Maple, Oak, Ash, Elm, Water level fluctuations, Foliar stress.

A water management program was begun in 1965 at the Montezuma National Wildlife Refuge in central New York to evaluate the feasibility of seasonally flooding bottomland hardwood forests to encourage their use by waterfowl. Two 120-ha bottomland hardwood impoundments were subjected to at least 12 years of continuous spring flooding (i.e., mid-March to late June). Mean water depth during flooding was 27-30 cm. There was little change in the composition of the major tree species present. Tree seedling survival flavored red maple (Acer rubrum), a species capable of reprospecies present. Tree seedling survival favored red maple (Acer rubrum), a species capable of reproducing vegetatively as well as by seed germination, over that of red sah (Fraxinus pennsylvania, swamp white oak (Quercus bicolor) and American elm (Ulmus americana). Among the herbaceous species, arrow arum (Peltandra virginica), swamp loosestrife (Decodon verticillatus), and Bidens spp. increased dramatically in mean density and frequency of occurrence, whereas less flood and shade tolerant species such as ferns were reduced. Growth rates of the major tree species in the impoundments were slower than those of trees samples in a nearby bottomland hardwood stand with natural water level fluctuations. Evidence of foliar stress in the overstory canopy of the flooded impoundments was apparent from analysis of aerial foliar stress in the overstory canopy of the flooded impoundments was apparent from analysis of aerial infrared transparencies. This was especially noted in one impoundment which retained water for a longer period due to soil type, topography, and dike design. The successful continuance of such a management scheme depends upon the recognition of the need to limit the duration of flooding, to provide for nonflooding years, to allow seedling establishment and to maintain the vigor of the existing plant community. (Moore-IVI) W85-00291

SMALL HYDROELECTRIC STATIONS AND THE ENVIRONMENT (ENVIRONMENT ET PETITES USINES HYDROELECTRIQUES), Conseil Superieur de la Peche, Clermont-Ferrand (France).

(France). R. Cuinat, and Ph. Roussel. Houille Blanche, No. 4/5, p 243-247, 1981. 2 Fig.

Descriptors: *Hydroelectric plants, *Environmental effects, *France, Mountains, Water resources development, Regulations, Resources develop-

In France, due to the increase in the price of oil, the value of other energy sources, such as small hydroelectric plants, has increased. The placement

of new small hydroelectric plants in certain mountainous regions may lead to the destruction of the last natural zones in those regions. Thus the lasting last natural zones in those regions. I hus the lasting effects of these structures may be out of all proportion to the power derived from the installation. The effects of small hydroelectric power stations on the environment are not significantly different from those of larger installations. The current regulations which deal with such installations. ulations which deal with such installations do pro-vide for a number of constraints on operators which are based on the size of the project and the quality of the environment. These constraints give quanty of the environment. I ness constraints give priority to protecting the aquatic environment, and particularly the aquatic fauna as well as the coun-tryside. A program has been established for the use of the waters in each hydrographic basin, to ensure balanced energy development that enables other uses of water to be preserved. (Baker-IVI)

COLONIZATION AND SUCCESSION OF BENTHIC MACROINVERTEBRATES IN A

BENTHIC MACROINVERTEBRATES IN A NEW RESERVOIR, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Entomology. J. R. Voshell, Jr., and G. M. Simmons, Jr. Hydrobiologia, Vol. 112, No. 27-39, 1984. 2 Fig. 5

Descriptors: *Benthos, *Colonization, *Succession, *Invertebrates, *Reservoirs, *Postimpoundment, *Lake Anna, *Virginia, Environmental effects, Sedimentation, Detritus, Dam effects, Spatial dis-

Lake Anna, a mainstream impoundment in Virginia, was constructed to provide cooling water for a nuclear powered electricity generating facility. The reservoir began filling in January 1972 and reached normal pool level in November 1972; the reservoir filled more quickly than expected because of flooding induced by a hurricane. Benthic macroinvertebrates were sampled for the first three years after filling by means of artificial substrates placed on the bottom and retrieved with SCUBA. Lake Anna was well colonized by benthic macroinvertebrates during the summer season immediately after impoundment. The total benthic macroinvertebrates during the summer aeason immediately after impoundment. The total density of organisms increased in each of the first three years. Major changes in the fauna occurred between the first and second years, but the changes between the second and third years were more subtle. The first colonizers appeared to be dependent upon the components of the former ecosystem for food and habitat. As autochthonous factors because to expulse succession discretizations are supported to the summer of the former ecosystem for food and habitat. As autochthonous factors are resulted to expense of the summer of the former ecosystem for food and habitat. began to regulate succession, diversity increased and the dominant species shifted to an assemblage of second colonizers. These factors included ecomposition of terrestrial vegetation and detritus composition of terrestrial vegetation and detritus leaving bare substrate, sedimentation, improved food quality of the organic matter in the sediment because of ingestion and egestion by the organisms themselves, increased plankton populations, and appearance of macrophytes. As the second colonizers became firmly established in the third year, distinct patterns of spatial distribution began to appear among species with similar niches. Herbaceous vegetation and coarse detritus from the terrestrial system stimulate the early colonization and restrial system stimulate the early colonization, and pre-impoundment basins should be prepared with this in mind. (Moore-IVI)

USE OF THE CHANNELS OF FLATLAND RIVERS FOR INTERBASIN WATER TRANS-

For primary bibliographic entry see Field 8B.

ARTIFICIAL SEISMICITY, CONDITIONS AND POSSIBLE MECHANISM OF OCCURRENCE OF DAM EARTHQUAKES,

OF DAM EARTHQUAKES,
N. I. Kalinin, and I. P. Kuzin.
Hydrotechnical Construction, Vol. 16, No. 6, p
295-303, June, 1982. 4 Fig. 1 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p
12-16, June, 1982.

Descriptors: *Earthquakes, *Dam construction, *Toktogul Reservoir, Reservoirs, Safety, Water

resources development, Tectonics, Seismic proper-

Examples are given of seismic activity caused by dam construction and reservoir filling. Observations in the zone of the Toktogul reservoir began 11 years before the start of filling. Spatial distribution of seismicity and its temporal variations were studied in the entire region (150 by 120 km), in the reach of the reservoir (40 x 70 km), and in the immediate vicinity of the dam (R = 15-20 km). Variations of seismic activity in 1972-76 in the immediate zone of the reservoir were clearly distinguished against the background of a general decline of seismic activity of the region. The number of relatively weak earthquakes increased by 2.5 to 4.0 times. Migration of the epicenters occurred toward the dam and lower pool. The earthquakes began to group along the Narya River channel and Karasu fault. The range of depths of the foci narrowed from 0-15 km to 0-5 km, and channel and Karasu tauit. The range of depths of the foci narrowed from 0-15 km to 0-5 km, and more than 50% of the tremors began to occur at depths of 0-5 km. The cyclic nature of the seismic activity correlated with the rate of variation of the reservoir water level with a correlation coefficient. of 0.59 and a two month lag time. The rise of the reservoir level above 100 m at the end of 1977 was followed by a marked relative increase in the number of weak earthquakes at the dam site. During triggering of induced earthquakes an inter-action of several factors related to different structural features probably occurs. The action of the surcharge propagates almost instantaneously, whereas the thermoelastic stresses and pore pressure are redistributed in depth for years. (Baker-W85-00466

CHANGE IN THE ICE AND THERMAL REGIME OF THE VILYUI RIVER IN THE LOWER POOL OF THE VILYUI I-II HYDROS-

S. N. Nazarenko, and N. B. Sakharova Hydrotechnical Construction, Vol. 16, No. 8, p 431-435, August, 1982. 3 Fig. 5 Tab, 1 Ref. Trans-lated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 23-26, August, 1982.

Descriptors: *Water resources development, *Environmental effects, *Vilyui River, Hydroelectric plants, Thermal pollution, Ice, Temperature.

A comparison of the thermal discharges of the Vilyui River at the site of the Vilyui hydroelectric station during the natural period and years of operation of the hydrostation gives a picture of the redistribution of the thermal runoff that involved changes in the thermal and ice regime of the river at a great distance from the hydrostation. The changes in water temperature, time of freezeup and breakup, ice thickness, and levels of the ice period on a 200-1000 km stretch from the hydrostation were traced. Under natural conditions winter water levels gradually decreased as the discharges decreased. With the operation of the plant, an decreased. With the operation of the plant, an increase of the winter water levels was noted and traced on a stretch more than 1000 km long. An onticeable decrease of the water temperature in the summer months was noted on a stretch up to 800 km long, and an increase of temperature in the spring and fall months in a stretch 600 km long. Disturbances of the ice regime of the river do not water the stretch of the contract of the Disturbances of the ice regime of the river do not extend farther than 400 km, in which case migration of the ice edge occurs in the 35-60 km stretch closest to the hydrostation and the formation of secondary polynyas in the ice cover is noted on riffle stretches at a distance up to 200 km. (Baker-W85-00480

7. RESOURCES DATA

7A. Network Design

EVALUATION AND DESIGN OF A STREAM-FLOW-DATA NETWORK FOR CONNECTI-

Data Acquisition—Group 7B

Geological Survey, Hartford, CT. Water Re-L. A. Weiss

Connecticut Water Resources Bulletin No. 36, Dept. of Environmental Protection, Hartford, 1983. 30 p, 12 Fig, 8 Tab, 24 Ref.

Descriptors: *Surface water, *Statistics, *Network design, *Hydrologic data collection, *Regression analysis, Peak flow, Low flow, Average flow, Drainage area, Geology, Rainfall, Hydraulic geometry, Stochastic hydrology, Gaging stations, *Connecticut, Bayesian analysis, Streamflow-data

A method of evaluating the transferability of streamflow information by regional regression analysis, intercorrelation of streamflow data, and Bayesian analysis was applied in Connecticut to several flow variables. The mean flow was chosen to represent the availability of water as a resource for development; the 2-year, 10-year, 50-year, and 100-year recurrence intervals of the annual peak series were chosen to represent flooding potential, and the 7-day and 30-day mean low flows for the 2-year and 10-year recurrence intervals were used to represent lowflow potential. The results indicate: (1) that the standard errors of estimate of the regression models are good approximations of the cate: (1) that the standard errors of estimate of the regression models are good approximations of the median true average errors of prediction of the Bayesian distributions of estimates of inaccuracy; and (2) for the streamflow variables used, little improvement can be expected in the regression relations by collecting more streamflow data. Improved regression models would be required to significantly reduce the errors. Future streamflow-data networks should contain only stations required for the design or coveration of water-required for the design or operation of water-re-sources projects, monitoring long-term trends or riparian demands, the investigation of water re-sources, and support of water-quality investiga-tions and flood-warning systems. (USGS) W85-00052

7B. Data Acquisition

APPLICATION OF LANDSAT IMAGERY TO FLOOD STUDIES IN THE REMOTE NA-HANNI KARST, NORTHWEST TERRITORIES,

Georgia Univ., Athens. Dept. of Geography. For primary bibliographic entry see Field 2A. W84-00024

REMOTE SENSING OF SUBSURFACE WATER RESOURCES IN THE U.S. VIRGIN ISLANDS. bean Research Inst., St. Thomas, VI.

M. J. Canoy.
Technical Report No. 14, September 1983. 21 p, 3
Fig, 4 Tab, 30 Ref. OWRT Project No. A-016-VI
(1), Contract/Grant No. 14-34-0001-1150.

Descriptors: *Remote sensing, Groundwater availability, Soil-water-plant relationships, Subsurface Waters, *Groundwater exploration, Virgin Islands, Aquifer location.

Location of areas for groundwater exploitation has been a long standing problem in the Virgin Islands. In response to this need a project was designed to briefly assess the possibility of using plant pigments surveyed from aircraft or satellites to locate aquifers. The results of this project indicate that:

(a) plant pigments can indeed be used to detect soil moisture changes, (b) the chlorophyll/carotioid ratio is especially useful, (c) technical difficulties prevent the type of remote sensing tried from being useful. Recommendations are made for design changes. W85-00065

BEHAVIOUR OF TURBINE, VORTEX AND ELECTROMAGNETIC FLOWMETERS, Cranfield Inst. of Tech. (England). Dept. of Fluid Engineering and Instrumentation. R. Baker, and J. Deacon. Chemical Engineer, Vol. 401, p 13-15, March, 1984. 5 Fig. 4 Ref.

Descriptors: *Flowmeters, Testing, Mechanical equipment, Turbine flowmeters, Vortex flowmeters, Electromagnetic flowmeters, Two-phase

Some recent tests on commercial flowmeters in air/water vertical upward flows are reported. Comparison is made with other published data. Results are presented which aim to give likely error envelopes for meter performance when a two-phase flow of low void fraction is present. The error being assessed is the error in the measurement of volume flow of the mixture. The tests indicated that the response of turbine meters in two-phase air/water flows, even at low void fractions, is unpredictable and liable to error; that for vortex flowmeters, vortex shedding appears to be stable up to about 10% air/water but that the bubbles may trigger the sensing elements leading bubbles may trigger the sensing elements leading to positive errors; and that electromagnetic flow-meters are likely to perform well even in quite severe two phase flow regimes. (Baker-IVI)

TIME-DOMAIN REFLECTOMETRY: SIMULTANEOUS MEASUREMENT OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVI-TY WITH A SINGLE PROBE,
Agricultural Research Service, Riverside, CA. Sa-

F. N. Dalton, W. N. Herkelrath, D. S. Rawlins, and J. D. Rhoades.
Science, Vol. 224, p. 989-990, June, 1984. 2 Fig. 6

Descriptors: *Soil water, *Measuring instruments, *Conductivity, Soil properties, Pore water, Salini-

Two parallel metallic rods were used as a wave guide to measure the dielectric constant and elec-trical conductivities but the account of the content. trical conductivity of soils having different electrical conductivities but the same water content. Measurements showed that the two parameters were sufficiently independent to permit simultaneous determinations of water content and bulk electrical conductivity. Only recently has the bulk medium electrical conductivity been used to esti-mate the pore-water electrical conductivity. Even mate the pore-water electrical conductivity. Even in the best instances, two separate measurements are needed to determine soil water content and pore-water electrical conductivity. When time domain reflectometry is used in conjunction with known relations between medium electrical contestinities and soil determined and contestinities. ductivity and soil water electrical conductivity, it provides a powerful new tool in soil water research because a single measurement can yield both soil water content and soil water salinity. (Baker-IVI)

MICROPROCESSOR-BASED DATA MONITORING AND CONTROL SYSTEM FOR A CONTINUOUS ION EXCHANGE PLANT, Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3A. W85-00251

VADOSE ZONE MONITORING CONCEPTS FOR HAZARDOUS WASTE SITES, Kaman Tempo, Santa Barbara, CA. For primary bibliographic entry see Field 5A. W85-00314

BOREHOLE COLLECTOR FOR IN-SITU CHEMICAL ANALYSES OF GROUND WATER, Lawrence Livermore National Lab., CA. Lawrence Livermore National Lab., CA.
J. E. Harrar, and E. Raber.
Ground Water, Vol. 20, No. 4, p 479-481, July-August, 1982. 1 Fig, 1 Tab, 5 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Water sampling, *Groundwater, Chemical analysis, Dissolved oxygen, Hydrogen ion concentration.

An apparatus has been designed for collection of groundwater samples in locations of limited water

flow when atmospheric contamination must be avoided. The apparatus impounds water for in-aitu measurement of dissolved oxygen, pH, and Eh (and subsequent chemical analyses) with a minimum of alteration in chemical composition. The collector system comprises a commercially available packer assembly installed in the 3-inch diameter, 10-ft deep borehole. This allows the borehole itself to act as the container for the water. The oxygen probe, which is a commercially available electrochemical device, functions accurately without water flow or oxygen consumption. (Moore-IVI) IVD W85-00328

EVALUATION OF ELECTROMAGNETIC METHODS FOR RAPID MAPPING OF SALTWATER INTERFACES IN COASTAL AQUIFERS,

University of South Florida, Tampa. Dept. of Ge-

Ground Water, Vol. 20, No. 5, p 538-545, September-October, 1982. 10 Fig, 3 Tab, 8 Ref.

Descriptors: *Saline-freshwater interfaces, *Mapping *Electromagnetic methods, *Coastal ping, *Electromagnetic methods, *Coastal aquifers, Saline water intrusion, Conductivity, Remote sensing, Terrain conductivity, Florida.

In coastal areas salt-water intrusion represents a significant threat to water quality in coastal aquifer systems. The electromagnetic (EM) method evaluated in this study proved to be rapid, very inexpensive, and it yields results which agree well with geologic and geochemical surveys using direct sampling. The instrument reads directly in conducsamping. The instrument reast directly in conduc-tivity units and the depth of investigation is con-stant for a particular spacing and orientation of the receiver and transmitter coils. Data can be ob-tained and interpreted by personnel with little technical training. Data interpretation normally involves producing terrain conductivity contour maps, but quantitative solutions can be obtained where the geoelectric section can be reasonably approximated by a two-layer section. Some problems were experienced with interference. However, interference sources usually were very localized and could be avoided. This study, conducted in two areas of Florida, demonstrates that the EM conductivity method is very useful for rapid, inex-pensive ground-water surveys where the objective is to locate zones of conductive pore fluids at depths less than 30-40 meters. Although interpretation is indirect and qualitative, neither data aquisition nor interpretation require special training. This characteristic of the EM method makes it very suitable for use by agencies where highly-trained technical personnel are not available. (Author's abstract) W85-00330

APPLICATION OF RESISTIVITY SURVEYS TO REGIONAL HYDROGEOLOGIC RECON-

University of South Florida, Tampa. Dept. of Ge-

ology. M. Stewart, M. Layton, and T. Lizanec Ground Water, Vol. 21, No. 1, p 42-48, January-February, 1983. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Resistivity, *Surveys, *Geohydrology, *Florida, Sounding, Water depth, Geophysics, Groundwater, Dissolved solids, Karst.

Vertical electrical soundings using DC resistivity methods have been completed along over 60 miles of survey lines in southwest Florida. The resistivi-ty soundings were obtained in order to outline ty soundings were obtained in order to outline major hydrogeologic features as part of a regional hydrogeologic investigation covering approximately 400 square miles. The two significant hydrogeologic features which can be effectively mapped on a regional scale by DC methods are the presence of shallow, high resistivity limestones associated with late Tertiary reef complexes, and the approximate depth to waters with total dissolved solids concentrations well above the potable water limits. concentrations well above the potable water limits.

An aquifer evaluation test indicates that these units have high transmissivities and are potential high

yield aquifers. Both the low quality waters and the karstic limestones can be distinguished on the resis-tivity cross sections from their bulk resistivity tivity cross sections from their bulk resistivity values. Compared to traditional curve-matching techniques the automated procedure is much faster and produces equivalent solutions. Contouring resistivity versus depth for closely spaced soundings lessens the problem of equivalence by averaging adjacent sounding solutions. Direct interpretation programs for smaller computers and programmable calculators require additional interpretation effort, but produce more consistent and theoretically sound solutions than empirical methods. (Baker-IVI) IVI) W85-00357

DIRECT ACQUISITION OF RAINFALL DATA ON SITE (SAISIE DIRECTE SUR LE SITE DE L'INFORMATION PLUVIOGRAPHIQUE). Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France). R. Ferrero, and G. Galea. Houille Blanche, Vol. 36, No. 7/8, p 471-478, 1981.

Descriptors: *Rain gages, *Rainfall, *Automation, *Data acquisition, Data processing, On-site data collections, Meteorological data collections.

Due to human and mechanical restraints, data on rainfall accumulated over variable time intervals could not previously be exploited, without major bias, beyond an hour-long time interval for inte-grating rain intensity. These restraints have been alleviated with the development of an automated rainfall data collection and data analysis system rannan data collection and cash analysis system that codes conditions directly on-site on magnetic casette tape using off-line coders. The recorder has six input channels and a flexible layout using a single digital input channel served by the six electronic meters of six 'strappe' channels; observation time is six minutes and each record contains 26 bytes. Layout is in accordance with ECMA norms 341. Each of the six meters accumulates the impulses generated during six minutes at each tilt of the cup. After 36 minutes, the contents of the meters are transfered in a single block to magnetic meters are transfered in a single block to magnetic storage. Data processing involves the use of a casette deck and software designed on TEK-TRONIX 16 K (read-in) and on IRIS 80 (processing), which are themselves integrated in the basic processing programs on hydrology and therefore articulated with the subsequent automatic processing. The system meets the conditions for acquisition and processing of rainfall data at an experimental catchment basin: temperature range of -75 C to 40 C; autonomy (power source for three months and cassette recording for 2.5 months): a months and cassette recording for 2.5 months); a six minute observation time which yields good knowledge of rainfall conditions over shorter peri-ods (seven observation periods of two seconds to sixty minutes); and negligible time drift which guarantees adequate synchronization of rainfall vents acquired by the various sensors. (Collier-IVI) W85-00388

HYDROLOGICAL MEASUREMENT USING A PUBLIC TELEPHONE SYSTEM (TELEME-SURE HYDROLOGIQUE PAR RESEAU TELE-

SURE HYDROLOGIQUE PAR RESEAU LELE-PHONIQUE COMMUTE, Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Dept. de Genie Rural. E. Persoons, and J. Laurent. Houille Blanche, Vol. 36, No. 7/8, p 479-485, 1981.

7 Fig. 7 Ref.

Descriptors: "Hydrologic data collections, "Te-lemetry, "Rainfall, "Meuse, "Belgium, "Data ac-quisition, Automation, River forcasting, Data in-terpretation, Rain gages, Meteorological data col-lections, Flood forecasting.

A telemetering system using the public telephone system was designed for hydrological measurements. It includes a central call unit which dials the phone numbers and measures the messages, and on-site phone receivers. These receivers require no local power. The latter have the advantages of requiring no external source of input and of transmitting data in pure analogue mode. Data are

either instantaneous or memorized locally. At the call-center, a central set managed by micro-proces-sor enables calls to be sent out either automatically sor enables calls to be sent out either automatically or manually; it can receive and measure the analog data received from the automatic receivers; and it can process this data in order to transform it into directly usable values which are then transferred to a mass memory. The receivers are compatible with an along or digital receivers. The information is returned at a precision of around 0.1 %. Eight microprocessor calling sets and more than 200 field material or the control of sets are in use on a permanent basis in Belgium. The Hydrological Study Service (HSS) equipped its measurement network with 65 telelimnimeters and 15 pluviographs. Using this network, the HSS was able to follow the flooding of the Meuse on July 20th and 21st, 1980 to a level recorded only once every hundred and fifty years; this real-time information enabled the duty officer to take the necessary precautions. (Collier-IVI) W85-00389

7C. Evaluation, Processing and Publication

HYDRAULIC CONDUCTIVITY, SPECIFIC YIELD, AND PUMPAGE – HIGH PLAINS AQUIFER SYSTEM, NEBRASKA, Geological Survey, Lincoln, NE. Water Resources

R. A. Pettijohn, and H. H. Chen. USGS Water-Resources Investigations Report 82-4014, 1983. 3 Maps, 15 Ref.

Descriptors: *Great Plains Province, *Nebraska, *Groundwater, *Aquifer, *Hydraulic conductivity, Specific yield, Pumpage, Application rates, Hydrologic data, *Maps, *High Plains aquifer system, Water-level decline, Irrigated acres, Irrigation-well

Hydrologic data used to evalute the ground-water potential of the High Plains aquifer system in Nebraska are presented on maps showing the hydraulic conductivity and specific yield of the aquifer system and the volume and distribution of water pumped for irrigation from the aquifer system underlies 177,000 square miles in parts of eight states, including 64,770 square miles in Nebraska. It consists of the Ogallala Formation and Tertiary and Quaternary deposits that are saturated and hydraulically connected to the Ogallala. The hydraulic lically connected to the Ogallala. The hydraulic conductivity of the aquifer system varies from greater than 200 feet per day in parts of the North Platte, Platte, Elkhorn, and Republican River valleys to less than 25 feet per day in the northwest-ern part of the state. Specific yield of the aquifer system ranges from 10 to 20 percent in most of the state and averages 16 percent. The estimated volume of water recoverable from the aquifer system in Nebraska is 2,237 million acre-feet. Inches of water withdrawn from the aquifer system during 1980 varied from less than 1.5 in the system during 1980 varied from less than 1.5 in the sandhills of north-central Nebraska to more than 12 in the Platte River and Blue River basins. This withdrawal represents about 6,703,000 acre-feet of ground water. (USGS) W85-00032

CONVEYANCE CHARACTERISTICS OF THE NUECES RIVER, COTULLA TO SIMMONS,

Geological Survey, Austin, TX. Water Resources For primary bibliographic entry see Field 4A.

W85-00033

HYDROLOGIC DATA FROM AN AREA SOUTHWEST OF TALLAHASSEE, FLORIDA, WHERE MUNICIPAL WASTEWAYTER EFFLU-ENT IS APPLIED BY SPRAY IRRIGATION, Geological Survey, Tallahassee, FL. Water Re-sources Div. M. C. Yurewicz

Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Open-File Report 83-769, 1983. 153 p, 9 Fig, 6 Tab, 9 Ref.

Descriptors: *Municipal wastes, *Spray irrigation, *Groundwater, *Monitoring, Hydrologic data, Well data, *Florida, *Floridan aquifer, Leon

The effects of spray irrigation using municipal wastewater effluent on a ground-water system (in particular, on the water of the Floridan aquifer) were investigated. The area irrigated was 4 miles southwest of Tallahassee, Florida, on an area covered in part by pine forest and in part by selected grasses and forage crops. Hydrologic and geologic data were collected from 1972 to 1981. Hydrologic data include ground-water leaves water coulsity measurements were made at 60 wells. Water-quality samples were collected at 1 municipal wastewater level wastewater effluent site, 3 springs, 17 soil sites, and 64 wells. Water-quality data were obtained from physical, chemical, and bacteriological analyses. Geologic data include geophysical logs and lithologic descriptions of 34 wells. (USGS) W85-00040 data include ground-water levels, water quality, and spray-irrigation rates. Ground-water level

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY KANSAS-FISCAL YEARS 1981 AND 1982,

Geological Survey, Lawrence, KS. Water Resources Div.

J. F. Kenny, and L. J. Combs. Available from the Ofss, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. USGS Open-File Report 83-932, 1983. 87 p, 9 Fig, 5 Tab.

Descriptors: *Groundwater, Aquifers, *Streamflow, Water quality, Water investigations, Water quality, investigations,

One of the primary missions of the U.S. Geological Survey in Kansas is to investigate the occurrence, quantity, quality, distribution, and movement of surface and groundwater throughout the State. Primary activities include the systematic collection, analysis, and interpretation of hydrologic determinations. data, evaluation of water demands, and water-resources research. Hydrologic investigations are conducted through four basic types of projects: (1) data-collection programs, (2) local or areal investigations, (3) statewide or regional investigations, and (4) research projects. These projects are funded through cooperative agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal funds. Fortytwo water-related projects were funded during fiscal years 1981 and 1982 in Kansas. This report describes for each of these water-resources investi-gations the problem that initiated the study, the objectives of the project, and the approach de-signed to achieve this objective. Information on signed to acmeve this objective. Information on data-collection stations in Kansas is presented in maps and tables. A list of reports approved for publication by the U.S. Geological Survey, its cooperators, or technical and scientific organiza-tions during fiscal years 1981 and 1982 is also provided. (USGS) W85-00041

8. ENGINEERING WORKS

8A. Structures

STRESS-DEFORMATION PREDICTIONS FOR

THE LG 4 MAIN DAM, Societe d'Energie de la Baie James, Montreal (Quebec). For primary bibliographic entry see Field 8D. W85-00141

SAND DAM

C. Y. Li, and J. Yague. Civil Engineering, Vol. 54, No. 6, p 46-49, June, 1984. 2 Fig.

Descriptors: *Dam design, *Sand dams, *Earth dams, *La Vueltosa Dam, *Rio Caparo, *Venezuela, Design criteria, Dam foundations, Foundation

Structures—Group 8A

The La Vueltosa Dam is located in Rio Caparo bordering the southeast states of Barinas and Merida. At 135 m high, the dam is part of the 1,250 Merioa. At 133 in figh, the dual is part of the 1,239 MW Urbante-Caparo hydrodevelopment scheme undertaken by the government in Venezuela. The foundation and abutment rock consists of soft and friable interbedded sandstone and siltstone, moderately pervious with occasional open fissures and cracks. The soft rock foundation would not permit construction of a high concrete dam. An innova-tive sand embankment dam was selected. Sand, being highly erodible, pervious and liquifiable, is usually considered an inferior material for conusually considered an inferior material for constructing a dam. To quard against embankment piping, the sand fill is completely confined to prevent migration of its fines by seepage flows in any direction. There is a clay and filter blanket over the entire foundation rock, a quadruple layer chimney drain downstream of the dam axis, and sand and gravel zones on outside dam slopes. To guard against foundation piping, there are multiple dense lines to control seepage through the foundation and abutments; a long seepage path, consolidation and curtain grouting, extensive drainage curtains in both abutments, and a complete drainage tains in both abutments, and a complete drainage blanket under the downstream shell. (Baker-IVI) W85-00157

HYDRAULIC CIRCUIT DESIGN AND ITS EFFECTS ON THE CIVIL ENGINEERING FEATURES OF LOCKS (LA CONCEPTION DES CIRCUITS HYDRAULIQUES ET SES REPERCUSSIONS SUR LE GENIE CIVIL DES POTLIGES)

For primary bibliographic entry see Field 4A. W85-00371

LOCKS ON THE WIDE-GAUGE RHONE WA-TERWAY (LES ECLUSES D'UNE VOIE A GRAND GABARIT: LE RHONE), For primary bibliographic entry see Field 4A. W85-00372

EFFECT OF LOCK-CHAMBER WATER DEPTH AND WATER-SAVING BASINS ON LOCK-OPERATING TIME (INFLUENCE DU MOUILLAGE DANS LE SAS D'UNE ECLUSE ET DE LA PRESENCE DE BASSINS D'E-PARGNE SUR LA DUREE D'ECLUSAGE),

Houille Blanche, No. 2/3, p 115-120, 1981. 10 Fig.

Descriptors: *Navigable waters, *Locks, Transportation, Efficiency, Design criteria, Locking cycles, Mathematical models.

The transport capacity of a navigable waterway is determined at least in part by the locking cycles. A locking cycle includes four boat movements - two openings and two exits, four gate operations - two openings and two closures, plus filling and emptying the lock chamber. The transport capacity of a waterway is therefore increased by shorter lock operating cycles. Plans for a future waterway link between the Scope and Rhope include a mathematical content of the cont operating cycles. Plans for a future waterway link between the Saone and Rhone include a mathemat-ical model study of lock filling and emptying con-ditions, allowing for adjacent canal reach dimen-sions and up to three water saving basins to make up for a possible water deficiency in the dividing reach, and a scale model study of the handling scope and possible movements of modern pusher units. (Baker-IVI) W85-00373

LOCK-FILLING AND EMPTYING WAVES AND LEVEL VARIATIONS IN CANAL REACHES (ONDES ET MARNAGES DANS LES BIEFS DUS AU REMPLISSAGE ET A LA VI-DANGE DES ECLUSES),

Houille Blanche, No. 2/3, p 135-140, 1981. 9 Fig.

Descriptors: *Waterways, *Locks, *Canals, *Waves, Water level, Design criteria, Pumps, Saone River, Rhine River, Canal du Nord, Mathematical models, Planning.

The transit time required to pass through the locks of a waterway determines the transport capacity of

that waterway. Transit time in turn depends particularly on the lock chamber filling and emptying speeds. Conditions in the adjacent canal reaches must be carefully considered in attempting to manipulate lock chamber filling and emptying times. Locking waves should preferably not exceed 0.30 m in height, with slopes of less than 1/1000. As the wetted cross-section of the canal decreases, these problems become increasingly critical. A mathematical model and in-situ studies on the Canal du Nord were both used in planning the design of the future Saone-Rhine waterway link. Many sections of this link are planned primarily around navigational requirements and thus the effect of lock operation on the canal reaches was of paramount concern. Water saving basins and booster pump stations will be supplied for some of the locks on this new waterway in order to make up for the effection of usual properties to the dividing reach. Also included in the mathematical model studies were several parameters which affect the level variations in the reaches such as locking, pump operations are settled (Backet IVI). ations in the reaches such as locking, pump oper-ation, and traffic. (Baker-IVI) W85-00374

SMALL HYDROELECTRIC INSTALLATIONS IN THE DEVELOPING COUNTRIES (LES PE-TITIES INSTALLATIONS HYDROELETRI-QUES DANS LES PAYS EN VOIE DE DEVE-LOPPEMENT).

J. Francou. Houille Blanche, No. 4/5, p 237-242, 1981. 3 Fig.

Descriptors: *Developing countries, *Hydroelectric plants, *Energy, Water resources development, Topography, Cost analysis.

The most immediate solution to satisfying the need for electricity by small industries or isolated cen-ters is the use of a diesel generator. The drawbacks to this solution are well known in countries which do not produce oil. Small hydroelectric installa-tions constitute an alternative under suitable cirnons constitute an anternative under suitable circumstances which may prove to be extremely cost effective. The topography, hydrology and technical qualifications of the community in question must all be considered in examining each case in question on its individual merit. (Baker-IVI) W85-00380

CHARACTERISTICS OF THE STATE OF STRESS AND STRAIN OF THE GRAVITY DAM AT THE KURPSAI HYDROELECTRIC STATION.

STATION, G. Yu. Berdichevskii, and Yu. P. Kornev. Hydrotechnical Construction, Vol. 16, No. 1, p 1-7, January, 1982. 6 Fig. 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 7-11, January, 1982.

Descriptors: *Stress analysis, *Dam construction, *Dam stability, *Kurpsai Hydroelectric Station, *USSR, Dams, Design criteria, Gravity dams, Hydroelectric plants.

The Kurpsai hydroelectric station is being constructed on the Naryn River 40 km downstream from the Toktogul hydrostation. An analysis was made of the characteristics of the state of stress and made of the characteristics of the state of stress and strain of the dam. Through various calculations determinations were made of the distribution of the external hydrostatic load between the vertical ele-ments and system of horizontal elements regarded as beams under shear or a transverse force in the case of a monolithic dam or only under a trans-verse force for the offset dam. The seismic load was determined for independent cantilevers in converse force for the offset dam. The seismic load was determined for independent cantilevers in conformity with construction specifications and regulations. The load distribution obtained was used in calculations of the stability and stress strain state of the dam. For checking the stability of each section the shearing load was assumed equal to the sum of the corresponding cantilever load and reaction of the horizontal element at the common support point with the cantilever. The stability of the structure was also checked experimentally. The experiments showed that a gravity dam of an unsectionalized design in a canyon has increased stability to shear compared to the stability of the highest section in the case of its independent work. An increase in stability was found to be due to the

occurrence of a longitudinal force which is the reaction of the channel sections to elastic displacements of the bank section downslope, and the formation within the dimensions of the dam of a formation within the dimensions of the unit of a secondary arch as a consequence of zero tensile strength across the joints and the occurrence of thrust increasing the restraining force at the dam contact. The occurrence of zones of tensile stresses across the concrete-rock contact causing decompression of the contact zone of rock under the upstream face of the bank sections is a result of the three-dimensional behavior of the dam. (Baker-IVI) W85-00427

OPTIMIZATION OF SITE SURVEYS BASED ON PRELIMINARY DESIGN ANALYSIS, Yu. A. Fishman

Hydrotechnical Construction, Vol. 16, No. 2, p 59-65, February, 1982. 4 Fig. 8 Ref. Translated from Gidrotechnicheskoe Stroitel'stvo, No. 2, p 11-15, February, 1982.

Descriptors: *Construction, *Design criteria, *Sites, Dam construction, Planning, Decision making.

making.

The effectivess of hydrotechnical construction depends on the interrelation between its surveys and designing. The traditional approach to planning surveys is inadequate. Not simply is a close contact between designing and surveys needed, but also their mutual overlapping, with the use of the so-called feedback principle, without which it is difficult to expect to obtain optimal results. One of the most effective ways of optimizing surveys is found at the junction between surveys and designing and consists of conducting calculations and designing studies for analyzing the effect of geological factors on the preliminary designs, which makes it possible to reveal the most important factors and to arrange the types of surveys according to the degree of their significance for the given hydrostatic and necessary detail of investigation. It is necessary to introduce into design and survey practice a preliminary calculated design analysis at the stage of contract and, especially, detail designs, making it possible to establish the most optimal composition, scope, and method of surveys. (Baker-IVI) (Baker-IVI) W85-00435

CALCULATION OF THE THREE-DIMENSIONAL STRESS-STRAIN STATE OF AN EARTH-ROCK DAM,

L. N. Rasskazov, and A. A. Belyakov. Hydrotechnical Construction, Vol. 16, No. 2, p 66-77, February, 1982. 6 Fig. 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 6-22, February, 1982.

Descriptors: *Dam stability, *Stress analysis, *Earth dams, Rockfill dams, Canyons, Mathematical models, Design criteria.

The design and construction of high earth-rock dams require a comprehensive study of their state of stress and strain and the effect of various topoor stress and strain and the effect of various topo-graphic, construction, and technological factors on the operational capability and reliability of these structures. In recent years calculations of the stress strain state of earth dams under conditions of the two dimensional problem have been so successful two dimensional problem have been so successful and the computational programs so economical that investigations based on the solution of series of two-dimensional problems with the use of factor analysis were undertaken. When solving two-dimensional problems, many factors (mainly topographic) are not examined. A study of the three-dimensional state of stress and strain of earth dams provided additional information on the behavior of the dam and permitted a more realistic evaluation. the dam and permited a more realistic evaluation of its performance. The behavior of an earth-rock of its performance. The behavior of an arti-rock dam in a canyon with a site coefficient equal to 2 is characterized by a substantial arching effect between the canyon walls and, since the level of normal stresses in the core is low, it is desirable to take technical steps to increase the crack resistance of the core. The results of solving the three-dimensional problem confirm the intense decrease of

Group 8A—Structures

horizontal displacements in the dam core, noted in on-site observations. A canyon shape curved in plan substantially increases the stability of a dam. (Baker-IVI)

DYNAMICS OF THE FORMATION OF AN ICE PRISM ON RESERVOIR SLOPES OF A PUMPED-STORAGE STATION, V. M. Kondrat'ev, M. N. Rubanik, V. F. Kanarskii, and P. D. Gavrish. Hydrotechnical Construction, Vol. 16, No. 3, p 132-137, March, 1982. 5 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 14-16, March, 1982.

Descriptors: *Pumped storage, *Reservoirs, *Ice prism, *Kiev Reservoir, *USSR, *Slopes, Stream-flow, Wind, Waves, Weather, Design criteria,

The on-site investigations being conducted at the Kiev pumped-storage station include observations of the state of the dike slopes of the reservoir, weather conditions, and wind wave and ice regimes. In all cycles of fluctuations of the water tausl in the numered storage preservoir under conductions. weather conditions, and wind wave and ice regimes. In all cycles of fluctuations of the water level in the pumped storage reservoir under conditions of negative air temperatures and positive water, concrete and soil temperatures of the slope, a redistribution of stresses occurs in the prism of layered ice, which at first is accompanied by viscous plastic and elastic deformations and then by the development of cracks alternately in the upper and lower zones of the prism working according to the accordion principle, which gives rise to the characteristics of the structure and mechanical strength of the ice in different prism zones. The formation of the multilayered ice prism is considerably promoted by the alternation of drawdown and pumping. The wind and presence of ice in the broken zone had a considerable effect on the rapid cooling of the exposed parts of the slope and ice prism. During a rise and drop of the water level at slow rates there occurs periodic wetting of level at slow rates there occurs periodic wetting of the vertical face of the prism, freezing of ice on it, and freezing of individual floes driven from the broken zone or circulating water to it. Such relationships may be used as grounds for developing as a first approximation a method of designing revet-ments of dike slopes of pumped storage reservoirs for the effect of ice. (Baker-IVI)

ON-SITE OBSERVATIONS AT THE ATBASHI

ON-SILE UBSERVATIONS AT THE ATBASHI HYDROELECTRIC STATION, I. N. Sakharov, A. N. Zhirkevich, V. Ya. Chichasov, and A. G. Zyryanov. Hydrotechnical Construction, Vol. 16, No. 4, p 189-195, April, 1982. 5 Fig. 3 Tab, 5 Ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 6-10, April, 1982.

Descriptors: *Hydroelectric plants, *Reservoirs, *Flushing, *Atbashi hydroelectric station, Spill-ways, Membranes, Films, Storage reservoirs, Sedi-

ments, Ice.

The Atbathi hydroelectric station with an installed capacity of 40,000 kW began operation early in 1970. The total capacity of its reservoir is 9.58 million cu m, the useful capacity of 4.34. million cu m at normal pool levels of 154 m and the dead storage level is 145 m. Since there is an excess of sediment and spongy ice lumps for proper operation of the hydrostation, deep annual flushing with complete drawdown of the reservoir during recession of the flood is necessary. Flushing was planned in stagges with alternation of a partial rise of the water level in the reservoir and discharge of the water level in the reservoir and discharge of the water for washing out the deposits formed in the lower pool. Periodic deep flushing is supplemented by constant flushing in the summer and fall by discharging surplus water at the 145 m dead storage level. The optimal flushing discharge should be 0.4-0.6 of the total discharge of the spillway at the normal pool level. Duration of flushing should be no more than 24-90 hr. In the case of flushing by repeated cycles, filling should be done to the normal pool level and this level maintained for 10-12 hr. During flushing there

were no substantial secondary adverse phenomena either in the lower pool or on the structures of the hydrostation. During flushing the chamber of the radial gate of the spillway, the gate itself, floors, and enclosures are covered with a layer of mud and enclosures are covered with a layer of mud from several millimeters to several centimeters thick, which in the cold season freezes and ham-pers operations. Increased seepage through the grout curtain in the rock walls is leading to dis-charge of seepage waters on the downstream shoulder of the dam. Drainage should be installed in the downstream slope of the dam with discharge of the water below the depth of freezing. (Baker-TVD) IVD W85-00448

HYDROCHEMICAL METHODS IN INVESTI-GATION OF SEEPAGE IN THE FOUNDATION OF STRUCTURES OF THE IRKUTSK HYDRO-

OF STRUCTURES OF THE IRRUTS HYDRO-ELECTRIC STATION,
M. D. Nikolaeva, and V. P. Kalenov.
Hydrotechnical Construction, Vol. 16, No. 4, p
203-209, April, 1982. 1 Fig. 4 Tab, 9 Ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p
14-18, April, 1982.

Descriptors: *Hydroelectric plants, *Seepage, *Measuring, *Irkutsk Hydrostation, Subsurface water, Chlorides, Carbon dioxide, Carbonates, Concrete, Cracks

Hydrochemical methods of investigating the seepage flow under conditions of the Irkutsk hydrostation should be used in combination with traditional methods of observing the condition of the structures. As indicators of the seepage flows and subsurface waters it is possible to use, along with mineralization of the water, the content in water of chloride ions and the sum of the derivatives of carbonic acid carbon dioxide, which in certain cases give a more accurate idea about the seepage flow in the foundation when determining the effect of water on concrete of the structures and grout flow in the foundation when determining the effect of water on concrete of the structures and grout curtain. Having distributed the content of the indi-cator in the piezometers along the equipotential lines of the seepage flow net, one obtains a clear picture of the distribution of seepage flows and subsurface waters in the foundation and body of the structures. The seepage flow net obtained by calculation or on the electrohydrodynamic analogy instrument does not always correspond to the actual picture of seepage, which somewhat reduces the accuracy of the proposed method. The preliminary conclusions about the mechanism of interacnary conclusions about the mechanism of interac-tion of the seepage flow with concrete of struc-tures require further refinement by setting up broader hydrochemical investigations of seepage, including seepage through cracks in the concrete. (Baker-IVI)

EXPERIENCE IN RESTORATION OF THE SPILLWAY DISSIPATOR OF THE HEAD HYDROELECTRIC STATION OF THE CHIR-YURT SEQUENCE.

E. Bravarnik. S. E. Bravarius. Hydrotechnical Construction, Vol. 16, No. 4, p 234-238, April, 1982. 3 Fig. Translated from Gi-drotekhnicheskoe Stroitel'stvo, No. 4, p 50-52, April, 1982.

Descriptors: *Hydroelectric plants, *Spillways, *Restoration, *Dissipators, Earth dams, Dam construction, Chir-Yurt Resevoir, Reservoirs.

The Chir-Yurt No. 1 hydroelectric station was constructed in 1962. At the dam site the maximum discharge over the course of many years was observed after the hydrostation was put into operation and amounted to 2120 cu m/sec. The earth dam has a wide central loam core and gravel shoulders, height of 37.5 m, and crest length of 450 m, creating a head of 32 m. The gates of the waste outlets are operated by chain mechanisms with a lifting capacity of 2 x 150 tons. The other gates are operated by a gantry crane with a capacity of 2 x 75 tons. In 1976 the sediments were flushed from the Chir-Yurt reservoir, totaling about 3 million cubic m of sediments being washed into the lower pool. Inspection in 1977 revealed the position of the dissipator bottom in its upper chamber did not

correspond to the design. The foundation slabs in the upper chamber of the dissipator had been ripped from their places and shifted 1.5 to 2 m in plan and the height position of the central slabs was considerably below design. Operators should not violate the rules of operating gates established in designs on the basis of hydraulic investigations. in designs on the basis of hydraulic investigations. An increase of the resistance of upilit and withdrawal of the apron slabs of the bottom of a dissipator should be achieved primarily by anchoring them to the foundation, which also saves construction materials. Protection of the surface of slabs and blocks of a dissipator from abrasion is achieved by placing on the slab surface a wear-resistant layer of high grade, heavily reinforced, well compacted and cured concrete prepared with well compacted and cured concrete prepared with strong crushed rock. (Baker-IVI) W85-00456

NEW TYPE OF STILLING BASIN (SEVAN CASCADE IN ARMENIA),

S. M. Isaakyan. Hydrotechnical Construction, Vol. 16, No. 6, p 333-335, June, 1982. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 32-33, June,

Descriptors: *Stilling basins, *Design criteria, *Sevan Cascade, *Armenia, Settling basins, Basins, Conduits, Scour, Deflectors.

A new design for a stilling basin is suggested for use in the transition section between pools of free-flow conduits with different hydraulic parameters. The primary area of use of this design is a lower pool of unlimited width having an erodible bottom and a small length along the flow. The design presented, in addition to the usual rectangular basin, has a deflector along the upper edge of the basin. The dimensions of the basin of the new design are smaller compared to a basin without a deflector. The advantage of the new design consists in the more concentrated dissipation of kinetic uenector. The avantage of the new design consists in the more concentrated dissipation of kinetic energy of the nappe and more uniform distribution of the water over the width of the lower pool, thus protecting the lower pool from the scouring action of the flow. (Baker-IVI) W85-00472

NEW PROBLEMS AND METHODS OF ENGI-NEERING-GEOLOGICAL EVALUATION OF FOUNDATIONS OF LARGE DAMS,

A. A. Borovoi, A. A. Varga, L. A. Molokov, I. A. Parabuchev, and L. V. Tolmachev. Hydrotechnical Construction, Vol. 16, No. 7, p 401-405, July, 1982. I Tab, 16 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 37-40,

July, 1982.

Descriptors: *Water resources development, *Evaluation, *Dam foundations, Dam construction, Foundations, Hydraulic engineering, Remote

Research is currently being performed to develop a set of scientifically founded methods and technical procedures for optimizing surveys. These include the expansion of the area of use of remote sensing methods, ir. Juding satellite and aerial land-scape surveying, for substantiating engineering geological mapping, studying seismotectonic structures and landslide hazardous areas and observing the character and extent of alterations of the environment in the zones of influence of reservoirs; the provision of the maximum information content of each prospect hole with the use of the arsenal of field methods; optimization of the system of engineering-geological testing as a whole on the basis of scientifically founded principles; the increase of the role of geophysical methods in survey works; the wider use in survey practice of quick field methods of investigating soils and rocks; a further increase of the role of quick methods in experimental seepage studies, automation of monitoring operations of the standard of the order of the role of quick methods in experimental seepage studies, automation of monitoring operations. increase of the role of quice, mentions in experimen-tal seepage studies, automation of monitoring oper-ations and processing of the results of hydraulic testing of boreholes; and the use of hydrochemical methods of investigations during drilling and regime observations for obtaining important addi-

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tional characteristics for solving a wide range of engineering-geological problems. (Baker-IVI) W85-00477

HANICAL EQUIPMENT OF GATE MBERS OF HIGH-HEAD SPILLWAYS, MECHANICAL L. F. Kochanov, and S. V. Farmakovskii.

Hydrotechnical Construction, Vol. 16, No. 8, p 463-469, August, 1982. 1 Fig. 4 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 45-50, August, 1982.

Descriptors: *Mechanical equipment, *Design criteria, *Spillways, Hydraulic engineering, Gates.

For the first time in design practice mechanical equipment of a gate chamber of a deep spillway has been designed with a vertical lift and radial regulating gates for passing discharges up to 2250 cm w/sec at heads up to 200 m with an area of an outlet being closed up to 50 ag m. The variant with an emergency-guard slide gate with an upstream pie-shaped contour of the seal located on the gate and a main slide gate with an upstream flat closed contour of the seal located on the gate can be main variant when developing the specifications. The high velocity jet is diverted from elements of the downstream part of the chamber at all openings of the main gate by appropriate selection of the orifice dimensions and shapes of the lower edge of the upstream skin plate of the main gate. When designing the number of bays of the gate chamber it is advisable to strive for the creation of standard-size mechanical equipment in order to improve its quality, increase operating reliability and increase the rate of construction works. The introduction of the developed equipment on the diversion tunes or what I avail of the and increase the fact of constitution works. The diversion tunnels on the I and II levels of the Rogun hydrostation makes it possible to reduce the cost of the gate chambers by 3.2 million rubles and to unify the mechanical equipment of the spillways of the hydrostation. (Baker-IVI)
W85-00484

EXPERIENCE IN THE OPERATION OF OVERFLOW BUTTRESS DAMS UNDER SEVERE CLIMATIC CONDITIONS, For primary bibliographic entry see Field 4A. W85-00486

DIVERSION OF STREAM THROUGH HYDROELECTRIC STATIONS WITH HIGH DAMS DURING CONSTRUCTION,

K. K. Kuz'min. Hydrotechnical Construction, Vol. 17, No. 9, p 419-424, September, 1983. 3 Fig. Translated from Gidroteckhnicheskoe Stroitel'stvo, No. 9, p 1-5, September, 1983.

Descriptors: *Dam construction, *Diversion channels, Tunnels, Spillways, Powerplants, Hydroelec-

The scheme of diverting the flow according to steps of construction of especially high dams is the basis of the site organization plan and also has a substantial effect on the design and layout of the main structures of a hydrostation. The best scheme of constructing a dam is that for which stream diversion is carried out through one level of spillways, later used as the service level. If it is impossible to accomplish this scheme, it is necessary to provide the possibility of operating a lower level of spillways until the higher level is completely ready for passing the flow, including floods. Designs of spillways gates of high dams, including the materials used in them, should be tested on simpler and less important structures. The layout of even temporary gates should provide the possibility of less important structures. The layout of even temporary gates should provide the possibility of repair of the movable parts and seals. The configuration of the spillway channels and the location of the regulating gates should be designated so as to eliminate or limit the possibility of the occurrence of conditions for the development of cavitation processes. The best solution in this case is to locate the regulating gate at the outlet of the pressure part of the spillway. The scheme of dissipating the energy of the flow in a stilling basin at heads of more than 120 m also has substantial shortcomings

complicating the preparation of the structures for stream diversion. (Baker-IVI) W85-00487

SEEPAGE IN THE FOUNDATION OF THE KRASNOYARSK DAM, A. P. Epifanov, V. A. Ulyashinskii, V. K. Semenov, and V. B. Idel'son. Hydrotechnical Construction, Vol. 17, No. 9, p 425-428, September, 1982. 2 Fig. 3 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 6-8, September, 1982.

Descriptors: *Seepage, *Dam foundations, *Kras-noyarsk Dam, Piezometers, Drainage wells, Foun-dations, Dam stability, Monitoring, Drainage

The Krasnoyarsk hydroelectric statio, has been operating since 1967. The foundation of the dam is composed of strong jointed granites, including individual veins of porphyrites, vogesites, and ayenites. Zones of tectonic crushing with a thickness up to 3 m run under the first column of sections 12-18 and 42-49. In the bank sections the heads measured by piezometers as a whole exceed the allowable values, but considering the absence of negative consequences of bypass seepage the observed values of the heads in these sections do not cause hazards. An analysis performed with the data from a large number of piezometers at the site and drain wells shows that intensification of seepage processes is not observed as a whole for the structure. The tendency toward an increase of the piezometric es is not observed as a whole for the structure. The tendency toward an increase of the piezometric head noted for individual piezometers and toward an increase of discharge noted for drain wells has a local character. Rearrangement of the foundation associated with its inhomogeneity is still continu-ing, which is indicated by the observed tendencies toward change in the piezometric heads and dis-charges. Observations and seepage monitoring in the dam foundation should therefore be continued. (Raker, 1VI) (Baker-IVI) W85-00488

EXAMPLES OF A COMBINED LAYOUT OF HYDROSTATIONS UNDER CONFINED MOUNTAINOUS CONDITIONS, O. V. Sitnin. Hydrotechnical Construction, Vol. 17, No. 9, p 467-470, September, 1983. 5 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No.9, p 38-41, September, 1983. September, 1983.

Descriptors: *Hydroelectric plants, *Mountains, *Diversion structures, Construction, Dam construction, Streamflow, Earth dams, Canyons, Tun-

Hydropower construction under mountainous conditions is hampered by the complex terrain, remoteness and difficult accessibility of the construction site, and the absence of transportation and power lines. The organization of the passage of the streamflow in many cases predetermines the design of the main structures and layout of the hydrostation as a whole. Two layouts are presented of hydrostations for mountainous conditions which solve the problem of passing diverted and operating flows by combining various functions in one structure. In one scheme a layout with an earth rock dam is suggested for the site of a station located in a V-shaped canyon with a slope steepness of 20-30 degrees in the absence of floodplain stretches. In the second example a station is located in a marrow canyon-type gorge with steep rock stretches. In the second example a station is located in a narrow canyon-type gorge with steep rock banks. Water is fed to the units of the hydrostation by bank tunnel penstocks or by penstocks in the body of the dam. The layout of a shift-type hydrostation with the use of a diversion tunnel as the operating spillway and penstock has a number of advantages compared with other layouts possible for this site. (Baker-IVI)

TECHNICAL ASSISTANCE OF THE USSR IN THE CONSTRUCTION OF HYDROELECTRIC STATIONS ABROAD,

N. A. Lopatin. Hydrotechnical Construction, Vol. 17, No. 10, p 481-487, October, 1983. 1 Tab. Translated from

Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 1-6, October, 1983.

Descriptors: *Hydraulic engineering, *Hydroelectric plants, *Argentina, *Peru, *Vietnam, Dam construction, Hydraulic structures, Developing ntries, Regional developm

In the Soviet Union the development of hydropower engineering is being accomplished generally on the basis of constructing large integrated hydropower developments. Detailed engineering surveys, thorough analysis and consideration of all possible acting factors in the calculation schemes of the structures, and conducting of model investigations has lead to a high reliability of the Soviet structures. The activities of the Soviet design organizations in hydraulic engineering undertakings in other parts of the world are described including the the Gabcikovo-Nad'maros hydropower system, the Euphrates hydropatain Al-Hadithsh ouner parts of the world are described including the the Gabcikovo-Nad'maros hydropower system, the Euphrates hydrostation, Al-Hadithah hydrostation, Al-Baas Dam, the Hao-binh hydropower development on the Da River in Vietnam, Olmos hydro complex in Peru, and the Chapeton hydropower development on the Parana River in Argentina, (Baker-IVI)

W85-00498

SOME TRENDS IN THE DEVELOPMENT OF GATE CONSTRUCTION ABROAD.

V. Ya. Marten Hydrotechnical Construction, Vol. 17, No. 10, p 487-495, October, 1983. 3 Fig. 4 Tab, 21 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 6-12, October, 1983.

Descriptors: *Dam construction, *Reviews, *Gates, Grooves, Mechanical equipment, Design criteria, Cavitation, Vibration.

Increasing attention is being devoted to increasing the reliability of outlet works and gates as a very important aspect of dam construction. For this purpose, types of gates, grooves, and mechanisms already checked in practice are used on newly constructed dams, and the main efforts of designers are aimed at improving their designs and layouts on structures. A trend is noted toward a substantial reduction of the number of types of gates being used. Serious attention is also being devoted to methods of preventing cavitation and vibration. An individual drive for each gate, generally electrohydraulic, having a number of operational advantages compared with cranes is gaining greater popularity. Reliability factors are considered also in the operating instructions which stipulate the need for periodic testing of the mechanical equipment. One of the current trends is a more cautious approach to the use of gates with high design approach to the use of gates with high design parameters, considering that failures of a large gate substantially reduce the discharge capacity of the dam. (Baker-IVI)

ARCHITECTURE OF FOREIGN HYDROELE-TRIC STATIONS,

For primary bibliographic entry see Field 6B. W85-00500

CUTOFF WORKS AT THE HAO-BINH HYDROSTATION IN VIETNAM, N. V. Imitriev, and I. G. Gal'perin

Hydrotechnical Construction, Vol. 17, No. 10, p 21-25, October, 1983. 4 Fig. Translated from Gi-drotekhnicheskoe Stroitel'stvo, No. 10, p 21-25, October, 1983.

Descriptors: *Hydroelectric plants, *Dam construction, *Cutoffs, *Da River, *Vietnam, *Hao-bih, Construction, Flood control, Powerplants, Earth dams.

The hydraulic structure of the Da River in the The hydraulic structure of the Loa River in the region of Hao-binh city in Vietnam will be a large flood-control and power development consisting of an earth dam 125 m high and 700 m long, a service spillway for a discharge of 3800 cu m/sec, a hydroelectric station with eight units having a

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total capacity of 1926 MW, and, in the future, locks. The site of the dam is V-shaped with a channel width of 250 m and slope steepness of 250 degrees. There is almost no floodplain and the width of the valley at the normal pool level is 700.800 m. Permeability coefficients of the fine and medium grained sands vary from 31.0 to 63.8 m/day, and those of the gravel-pebble deposits vary from 83.5 to 390.0 m/day. After creating the reservoir with a NPL of 215 m, the barrier zone will include: the slideprone mass of the Elephant Ridge on the side of the right bank abutment of the dam; an earth dam with a central loam core; the main concrete structures - spillway and underground powerhouse - in the left bank abutment of the dam on the left bank, the karstified limestones of the Chai-Nhianh massif; and on the left bank, in the future, the upper single lock. Work in each of these areas is described. (Baker-IVI)

EXPERIENCE IN OPERATING THE STRUC-TURES OF THE MANSOUR EDDAHBI HY-DROPOWER DEVELOPMENT, For primary bibliographic entry see Field 4A. W85-00502

DOKAN HYDROELECTRIC STATION IN IRAQ,

A. K. Fink, and I. D. Ostrizhnov. Hydrotechnical Construction, Vol. 17, No. 10, p 519-522, October, 1983. 5 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 30-32, October, 1982.

Descriptors: *Hydroelectric plants, *Design criteria, *Dokan hydroelectric station, *Iraq, Concrete, Hydraulic engineering, Cranes, Dam foundations.

The design of the Dokan hydroelectric station corresponds for the most part to the traditional designs of reservoir stations. Distinctive features include: the construction in the right bank abutment of the station to the assembly area of a reinforced concrete trestle in the zone of one unit for delivering equipment by gantry crane to the floor of the generator room in the zone serviced by the bridge crane of the station; the layout of the powerhouse and administration production building is based on a combination of the massive volume of the generator room and more openwork structure of the building; sectionalization of the foundation slab of the draft tubes by joints from the piers, their anchorage by means of anchors in the rock mass, and relief of seepage and uplifting forces on the foundation slabs by means of relief wells; the ceiling of the turbine room resting through a reinforced concrete cone on the turbine stator; and construction in the rock surfaces of the end abutments of systems of vertical and inclined drainage ditches which were covered by channel iron when concreting the end walls of the station—this makes it possible to drain the water flowing through cracks into the rock mass during showers. [Baker-IV] W85-00503

ENGINEERING-GEOLOGIC ASSESSMENT OF THE CHALK STRATA OF THE TABQA HY-DROELECTRIC STATION ON THE EUPHRA-TES RIVER WITH CONSIDERATION OF OP-ERATING DATA, V. A. Moshchanskii, and I. A. Parabuchev.

V. A. Moshchanskii, and I. A. Parabuchev. Hydrotechnical Construction, Vol. 17, No. 10, p 36-38, October, 1983. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 36-38, October, 1983.

Descriptors: *Hydroelectric plants, *Dam construction, *Euphrates River, *Syria, Alluvial soil, Chalk, Permeability, Seepage, Dam foundations.

The hydropower development at As-Saurah in Syris has a multiple purpose and is one of the largest hydraulic structures in the Near East. In the foundation of the powerhouse of the hydroelectric station and floodplain-channel dam occur only Oligocene chalks covered by a thin layer of modern alluvium which was removed both in the zone of the foundation pit for the powerhouse and

from under the central part of the earth dam. The greatest difficulties for siting the powerhouse arose, owing to the presence in the chalk strata of bentonite interlayers, for which the design strength after a thorough laboratory and field study was determined. The facility has been in operation more than 6 years under a full head and the design has been proved to be completely stable. The permeability of the chalks strate was estimated from the results of pumping and injection tests. Permeability of the chalks proper is extremely small. Onsite observations of seepage on the floodplain channel part of the earth dam show that the seepage line behind the dam core for all five piezometric monitoring cross sections exceeds by only 1.0 m the lower pool level, and the gradient to the head in the alluvial interlayer behind the dam core are about 0.0016-0.0020. (Baker-IVI) W85-00506

GROUTING WORKS IN THE FOUNDATION OF THE DAM OF THE AL-HADITHAN HY-DROPOWER DEVELOPMENT ON THE EU-PHRATES RIVER IN IRAO.

PHRATES RIVER IN IRAQ, N. V. Dmitriev, and L. I. Malyshev. Hydrotechnical Construction, Vol. 17, No. 10, p 534-542, October, 1983. 6 Fig. 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 41-47, October, 1983.

Descriptors: *Grouting, *Earth dams, *Dam construction, *Euphrates River, *Iraq, Dolomites, Soil properties, Sand, Gravel, Construction materials, Concrete, Permeability, Dam foundations.

The combined earth dam with a central part of the dolomites, shoulders of sand-gravel materials, and an asphalitic concrete cutoff wall has a maximum height of 57 m, base width of 325 m, and crest width of 20 m. A grout curtain with a depth up to 100 m and total length in plan of about 16 km is provided for in the foundation and baak abutments of the dam, and a drainage system is provided in the base of the downstream shoulder of the dam. The parameters of the grout curtain (depth, number of rows, and spacing of the grouting holes), technology of performing the works, and criteria of the quality of grouting ensure reliability of the structure. The groutability of the rocks along the front and over the depth of the curtain is substantially different. A high effectiveness and density of grouting is achieved in layers of the Ana suite; grouting is less dense in the rocks of the Euphrates and Baba suites owing to the presence of pore permeability. The rocks on the completed sections of the curtain are well grouted, solidity of the curtain is provided, and the actual specific water absorption in cross sections of the curtain is greater than those calculated according to the design. Grouting and hydraulic testing in the fractured porous dolomites of the Euphrates suite are possible only with a gradual increase of pressure and limitation of the injection rate. The permissible rate of 20-80 1/min depends on the particular geological conditions and on the condition of the rocks and their surcharge. (Baker-IVI)

8B. Hydraulics

GRAVITY CURRENT UPSTREAM OF A BUOYANT INFLUX IN AN OPEN-CHANNEL FLOW: A NUMERICAL STUDY,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Mechanical and Industrial Engineering. D. T. Valentine, and T. W. Kao. Journal of Fluid Mechanics, Vol. 140, p 303-327, March, 1984. 17 Fig. 1 Tab, 23 Ref. NSF grants NSF 77-01496 and CEE-83-08405.

Descriptors: *Open channels, *Channel flow, *Flow profiles, *Gravity currents, Diffusion equations, Navier-Stokes equation, Froud number, Laminar flow, Buoyant fluids, Cooling water systems, Boundary layers, Velocity.

The establishment of an upstream intrusion of a buoyant fluid discharged into an open-channel flow of uniform density and finite depth is studied

numerically using the full Navier-Stokes and diffusion equations. The problem is posed as an initial boundary-value problem for the laminar motions of a Boussinesq fluid. The equations are integrated numerically by finite-difference methods. The flow patterns produced are controlled by the influx of buoyancy; therefore they are characterized by an inflow densimetric Froude number. A comparison with available experimental data provides favorable support to the theoretical predictions. The critical value of densimetric Froude number of the source of a vertically downward inflow at the free surface of a channel is determined. For densimetric Froude number less than critical, an intrusion is established on the upstream side of the source. Because dissipative mechanisms associated with viscosity take a finite time to intervene, the intrusion starts as an inviscid gravity current with a propagation speed greater than the surface velocity of the stream. The front speed is proportional to the phase velocity of long internal waves. Subsequently, the front decelerates as the interfacial friction, and, if applicable, the boundary frictional forces increase simultaneously with mass entrainment across the interface. The current slows down towards a two-zone equilibrium: (1) the zone encompassing the current behind the frontal zone, where a steady state is approached with respect to the inertial frame of reference; (2) the frontal zone, where the upstream speed approaches a steady state is approached with respect to the inertial frame of reference; (2) the frontal zone, where the upstream and downstream currents is the presence of surface convergence with concomitant downwelling near the fronts. As the upstream front decelerates, wavelike disturbances are excited just behind the front at frequencies characteristic of internal waves. As the front approaches steady state, these disturbances appear to be damped. This problem has practical implications in the design of once-through cooling-water systems for power plants taking t

TURBULENT NON-BUOYANT SURFACE JETS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.

N. Rajaratnam, and J. A. Humphries. Journal of Hydraulic Research, Vol. 22, No. 2, p 103-115, 1984. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Jets, *Diffusion, *Turbulence, Lakes, Rivers, Stagnant waters, Thermal pollution, Stratification, Mixing, Plumes.

An experimental study was performed on the diffusion of plane and bluff turbulent surface jets. For plane surface jets, twa found that its length scale grows at the same rate as a plane wall jet with its velocity scale being about 0.9 times the corresponding value for the plane free jet. For bluff surface jets, the vertical length scale increases at about the same rate as bluff wall jets whereas its transverse length scale grows at about half the rate of the corresponding bluff wall jets. The velocity scale decays inversely with the longitudinal distance, but the constant in the velocity scale relation is somewhat higher than that for the corresponding free circular jet. By studying the diffusion of relatively simpler non-buoyant plane and bluff surface discharges into deep stagnant surroundings, the effects of density differences and freestream influences could be separated out. The results can be used as a basis for studying the influence of the source Richardson number for buoyant discharges and the influence of the Richardson number plus the ratio of the velocity of the surface discharge to that of the freestream while dealing with a moving ambient. (Baker-IVI) W85-00195

NON-BUOYANT AND BUOYANT CIRCULAR SURFACE JETS IN COFLOWING STREAMS, Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam.

Journal of Hydraulic Research, Vol. 22, No. 2, p 117-140, 1984. 17 Fig, 2 Tab, 3 Ref.

Descriptors: *Jets, *Turbulence, *Coflowing streams, Stream flow, Velocity, Channels, Thermal pollution, Buoyant surface jets, Circular jets.

One method of discharging thermal effluents into rivers is to use circular surface jets discharging in the same direction as the river flow (surface jets in a coflowing stream). Based on an experimental study on the diffusion of circular turbulent buoyant surface jets in coflowing streams of large width and depth, it was found that the velocity distribution in the center plane as well as in the planes containing the maximum velocity with respect to the freestream are similar. The velocity scale as well as the vertical and transverse length scales the freestream are similar. The velocity scale as well as the vertical and transverse length scales have been analyzed using the excess momentum thickness as the length scale and the source Richardson number as a parameter. The variation of the velocity scale is not affected to any significant extent by the buoyancy effects whereas the transverse spreading rate is increased and the vertical spreading is almost zero for longitudinal distances greater than a few times the momentum thickness. Some preliminary observations have also been made on the effect of shallow depths in the channel on the diffusion of the buoyant surface jets. [Baker-IV] (Baker-IVI) W85-00196

STUDY OF THE BEHAVIOR OF BOATS AND UNITS UNDER CROSS-CURRENT AND WIND ACTION AT THE ENTRANCE TO THE FOS-RHONE CANAL LINK (ETUDE DE L'EVOLU-RITUDE CANAL LINK (ETUDE DE L'EVOLU-TION DES BATEAUX ET CONVOIS SOUMIS AUX COURANTS TRAVERSIERS ET AU VENT, A L'ENTREE DU CANAL DE LIAISON FOS-RHONE),

J. Megard, and P. F. Demenet. Houille Blanche, Vo. 2/3, p 151-158, 1981. 8 Fig.

Descriptors: *Navigable waters, *Water resources development, *Fos-Rhone Canal Link, Waterways, Decision making, Planning, Model studies.

A river link between the industrial and harbor areas at Fos-sur-Mer close to the Mediterranean is to be provided by a scheme to develop the Rhone for navigational purposes. Studies are underway of the various river engineering problems which will be encountered in carrying out the scheme. A model study was made of the intake configuration of the canal to the Rhone in order to prevent the canal entrance from silting up with sand and to ensure suitable velocity distributions in the entrance for shipping. These two requirements proved to be somewhat contradictory and a compromise solution was finally adopted which met the necessary requirements for navigation. Calculation and graphical methods were used to investigate unit manuverability on the basis of flow velocity patterns determined by model studies. Due allowance was made for both unit characteristics and wind action. (Baker-IVI) A river link between the industrial and harbor

EFFECT OF SUSPENDED SEDIMENTS ON HYDRAULIC RESISTANCES OF A CHANNEL. HYDRAULIC RESISTANCES OF A CHRISTIAN, N. B. Bekimbetov, and K. I. Baimanov. Hydrotechnical Construction, Vol. 16, No. 1, p 37-39, January, 1982. 7 Fig. Translated from Gotto-tekhnicheskoe Stroitel'stvo, No. 1, p 29-31, January

Descriptors: *Hydraulic resistance, *Channels, *Suspended sediments, *Amu Darya, Sediments, Canals, Scouring, Turbidity, Irrigation canals, Hy-

Investigations of the kinematic structure of the flow and effect of the content of suspended sediments in the flow on the hydraulic resistance were carried out in a number of unlined canals of the basin of the Amu Darya River. The distribution of the longitudinal flow, selective was measured as basin of the Amu Darya River. The distribution of the longitudinal flow velocities was measured at 6 points on the vertical. Water samples were taken for determining the turbidity along the vertical as well as near bottom turbidity. With a decrease of flow, a large amount of sediment accumulated in the near-bottom zone while suspended sediments passed both into a traction state and into bottom deposits. In canals of the Amu Darya irrigation deposits. In canals of the Amu Darya irrigation system, in the absence of scouring and silting, the value of the roughness coefficient with increasing dimensions, decreases and has a certain value characterizing a stable state of the canals, whereas, in the presence of scouring, conversely, the value of n increases. With a decrease in dimensions of the canals the value of n also increases owing to the nonuniform roughness of the bottom and effect of the side walls. Near bottom turbidity and various operating regimes of the canals were interrelated. In channels with a rough bottom the intensity of transport by turbulent fluctuations increases and the dimensionless velocity gradient decreases with increases in the height of the roughness projections. (Baker-IVI) tions. (Baker-IVI) W85-00431

DETERMINATION OF THE HYDRAULIC ROUGHNESS OF A VEGETATED FLOOD-

ary bibliographic entry see Field 2E. For primar W85-00437

CALCULATION OF THE SEEPAGE OF RESERVOIR DIKES OF PUMPED-STORAGE STA-

110NS, P. D. Gavrish, V. M. Kondrat'ev, M. N. Rubanik, V. F. Kanarskii, and V. K. Rudakov. Hydrotechnical Construction, Vol.16, No. 3, p 143-148, March, 1982. 3 Fig, 2 Tab, 5 Ref. Trans-lated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 20-22, March, 1982.

Descriptors: *Dikes, *Design criteria, *Pumped storage, Slope stability, Seepage, Stability, Slopes, Mathematical equations, Free surfaces.

When designing reservoir dikes with daily regulation of the water volume the problem of calculating the seepage stability of the slopes of these structures arises. To solve this problem it is necessary to predict the dynamics of the free surface of the seepage flow in the earth dike under conditions of considerable daily fluctuations on the water level in the reservoir. The seepage flow in dikes of daily storages in the period of drawdown of the water levels from the normal pool level to the dead storage level and standing of the water at the dead storage level can be schematized in the form of an extended groundwater mound. In plan the mound represents a strip located inside a homogeneous bed not bounded over the length of the structure and bounded over the length of the structure and bounded over the solution of the solution of which provides the rate of spreading of the mound, boundary conditions, and other factors. Mathematical equations are derived the solution of which provides the rate of spreading of the groundwater mound in dikes of daily storages and predicts the character and effectiveness of the action of the water of the mound on the slope as a function of the design of the structure. (Baker-IVI)

EFFECT OF THE RESERVOIR FILLING REGIME ON THE STRESS AND STRAIN STATE OF AN EARTH-ROCK DAM, Yu. K. Zaretskii, and V. V. Orekhov. Hydrotechnical Construction, Vol. 16, No. 3, p 155-160, March, 1982. 3 Fig. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 36.20 March. 26-29, March, 1982.

Descriptors: *Earth dams, *Design criteria, *Reservoir operation, Stress analysis, Stress-strain curves, Deformation, Clay.

When substantiating the selection of a rational design of an earth-rock dam in relation to the geotechnical properties of the local construction materials and construction technology and conditions, its stress and strain state should be predicted. Such a prediction is especially important for determining the crack resistance of watertight elements of the dam, deformations of the dam in the con-

struction and operating periods, and also in cases when systematic deep drawdown of the reservoir is carried out. For a more complete consideration of the properties of clay soils which serve as the material of watertight elements and are multiphase systems the reported calculated predictions are based on solving equations of the theory of consolidation, which examines processes of long term consolidation of saturated soils. From the analysis it is concluded that the effect of the loading trainer. consolutation or saturated soils. From the analysis it is concluded that the effect of the loading trajectory associated with the reservoir filling regime is substantial on the behavior of an earth rock dam. This factor is taken into account in the frameworks of the theory of plastic gain in strength in calculations of the state of stress and strain on earth dams. (Baker-IVI) W85-00445

USE OF THE CHANNELS OF FLATLAND RIVERS FOR INTERBASIN WATER TRANS-

Ya. R. Polyakov

Hydrotechnical Construction, Vol. 16, No. 4, p 217-220, April, 1982. 1 Tab. Translated from Gi-drotekhnicheskoe Stroitel'stvo, No. 4, p 23-24,

Descriptors: *Floodplains, *Channels, *Interbasin transfers, *Water transfer, *Dnepr-Conbas Canal, Canals, Environmental effects, Sedimentation,

The construction of the first phase of the Dnepr-Donbas canal with intake of water from the Dne-prodzerzhinsk reservoir on the Dnepr River and its discharge into the Northern Donets River has been completed. Many specialized research organiza-tions have been encount in forcesting the comtions have been engaged in foecasting the conse-quences of a change in the hydrological regime of quences of a change in the hydrological regime of the river and hydrogeological setting of the flood-plain. The passage of increased dry-weather dis-charges in individual stretches of flatland rivers has a favorable effect on the development of flora and fauna of the floodplain. In the case of interbasin water transfer a degrees of bottom sediments will water transfer, a decrease of bottom sediments will occur due to the discharge of clarified water, which in the future will lead to a further increase of the channel capacity. The use of channels of flatland rivers for interbasin transfer without pernatland rivers for interbasin transfer without per-forming dredging works produces a substantial economic effect. The theoretical investigations and development works performed and also the planned full-scale investigations can be used when working out interbasin water transfer projects with the use of the channels of existing rivers. (Baker-W85-00452

REFLECTION OF A SURGE FROM A VERTI-CAL WALL.

For primary bibliographic entry see Field 2E. W85-00454

MEASUREMENT OF DISCHARGE IN PRES-SURE CONDUITS BY MEANS OF SEGMENT-

SURE CONDUITS BY MEANS OF SEGMENT-ED CONSTRUCTORS, B. M. Levin, and A. N. Lopatin. Hydrotechnical Construction, Vol. 16, No. 6, p 317-323, June, 1982. 6 Fig. 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 24-27, June, 1982.

Descriptors: *Orifice flow, *Pressure conduits, Measuring, Flow, Orifices, Discharge, Resistance.

Systematic investigations of segmented constrictors were conducted, the use of which is prospective for measuring the discharge of suspension transporting flows in large-diameter water lines operating in hydraulic and drainage systems and at large pumping stations of reclamation systems. The experiment was conducted with segmented orifices with a sharp inlet edge in smooth pipes with a diameter of 105 and 143 mm by the angle pressure lead method. On the basis of the experimental data the initial discharge coefficient was determined as a function of the relative area of the orifice m in the range 0.5 is less than or could ton which is less the range 0.5 is less than or equal to m which is less than or equal to 0.957. The confidence interval is

Field 8—ENGINEERING WORKS

Group 8B—Hydraulics

plus or minus 0.75% with a 95% confidence level. An advantage of segmented orifices is the possibity of using them at large values of m, up to 0.957. The flow resistances in this case are small, and the The flow resistances in this case are small, and the orifice installed in the upper half of the pipe section unimpededly passes the solid suspension. The manufacture, installation, and dismantling of the orifices with large m are uncomplicated also for large diameter pipes. Blunting of the inlet edge has less effect on the readings of the segmented orifices than on the readings of normal orifices. (Baker-IVI) W85-00469

NEW METHOD OF DETERMINING THE STABLE CROSS SECTION OF A CHANNEL IN COHESIONLESS SOILS, Yu. A. Jbad-Zade, M. Ya. Krupnik, and E. A.

Hydrotechnical Construction, Vol. 16, No. 6, p 335-341, June, 1982. 4 Fig. 1 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p

Descriptors: *Channels, *Cohesionless soils, Soil properties, Stability analysis, Mathematical studies, Suspended sediments.

The method for calculating a stable cross section of a channel was obtained on the assumption of the absence of sliding of soil particles on the canal bottom. Adhering to this principle, the form of a stable channel cross section is constructed. The forms of the channel were calculated for the Kara-Kum and Upper Karabakh canals on the Minsk-32 computer. The results showed that Ibad-Zade's weeked the treating force method and these computer. The results showed that Ibad-Zade's method, the tractive force method, and the proposed method give a relatively good convergence with the actual profile. The divergence between the transverse profiles constructed by these methods and the actual profiles did not exceed 6-7% on average. The method described in the article can look be straight to inhomogeneous soils of a canal also be extended to inhomogeneous soils of a canal in which a suspended load will be transported. (Baker-IVI)

EFFECT OF BREAKING WAVES ON STRUC-TURES WITH AN INCOMPLETE VERTICAL

PROFILE,
O. Yu. Birskaya, and G. D. Natal'chishin.
Hydrotechnical Construction, Vol. 16, No. 6, p
354-357, June, 1982. 2 Fig. 1 Tab, 2 Ref. Translated
from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 45-47, June, 1982.

Descriptors: *Waves, *Breakwaters, *Hydraulic structures, Construction, Vertical distribution, Dam construction, Coastal zone management.

Structures with an incomplete vertical profile over which water is allowed to flow due to lowering the elevation of the top are sometimes used in the construction of breakwaters and coast protection works. In the standards, there are no recommendations for determining the wave loads and coefficient of wave supersession when best here commended to the commendations of the commendations are supersession when best here commended to the commendation of the tions for determining the wave loads and coeffi-cient of wave suppression when breakers act on structures having an incomplete vertical profile. Investigations were conducted in a wave flume measuring 30 x 1.4 x 1 m, where at a scale of 1:30 the profile of the sea bottom from the water line to a depth of 12.0 m was prepared. The model of the breakwater was installed at a depth of 10 m, 100 m from the water line. An equation was derived which can be recommended for determining the winca can be recommended for determining the coefficient of wave suppression by a structure with an incomplete vertical profile. To determine the wave loads from breaking waves on structures with an incomplete vertical profile, one can use the appropriate recommendations of SNiP 11-57-75 with consideration of the described corrections with respect to calculating the horizontal and uplifting forces of the wave pressure. (Baker-IVI) W85-00474

DETERMINATION OF WATER PRESSURE IN PRESSURE TUNNELS AND CONDUITS UNDER A SEISMIC LOAD, D. N. Kilasoniya, and G. P. Mamradze. Hydrotechnical Construction, Vol. 16, No. 6, p 357-364, June, 1982. 4 Fig, 2 Tab, 9 Ref. Translated

from Gidroteckhnicheskoe Stroitel'stvo, No. 6, p 47-51, June, 1982.

Descriptors: *Seismic properties, *Pressure, *Tunnels, *Conduits, Construction, Mathematical equations, Decision making, Water pressure, Comput-

During seismic oscillation of the ground a dynamic water pressure occurs in pressure tunnels or conduits which in certain cases exceeds the value of the static pressure. It evidently has also a substantial effect on the seismic stress state of the tunnel lining and adjacent ground. The problem of determining the seismic pressure of water in pressure that the seismic pressure of water in pressure that the seismic pressure of water in pressure that the seismic pressure of water in pressure of water in the seismic pressure of water in pressure that the seismic pressure of water in the seismic pressure in the seismic pres tunnels and underground conduits was investigated. Oscillations of water pressure in a pressure ed. Oscillations of water pressure in a pressure system are described by water hammer equations which for a system performing seismic oscillations is presented. Within the scope of the two-dimensional problem of elasticity theory and on the basis of the finite-element method, a method and program were developed for computer calculation of the seismic stress state of a tunnel lining with consideration of the seismic water presssure pre-liminarily determined as a result of numerical calculations. (Baker-IVI)

OUTLINE OF AN INCLINED HEAD WALL OF A DEWATERING OUTLET, Ya. R. Berman.

Hydrotechnical Construction, Vol. 16, No. 8, p 459-462, August, 1982. 2 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 41-43, August, 1982.

Descriptors: *Flow, *Water pressure, Head wall, Multiphase flow, Concrete dams, Drainage, Irrigation, Pressure, Conduits, Tunnels.

The two dimensional problem of flow of an ideal incompressible weightless fluid past an inclined head wall is examined. Under conditions of a real flow the problem of flow past the head wall is three dimensional, since outlets have comparatively small transverse dimensions. The use of projecting piers at the head wall leads to a plane-parallel flow at the entrance of the outlet. The flow can be described to the consideration of the contraction of considered as two dimensional both in the head wall and in the initial section of the conduit. Proposed outlines of head walls with inclined pressure faces have greater compactness than elliptical head walls. The recommended method makes it possible wans: The recommender memor makes i possible to reduce laboratory investigations to a check of the result found by calculation. It is possible to find the dimensions of the head wall from the minimum dimensions of the gate closing the inlet opening. The method of calculating the coordinates of head walls proposed here can be used when designing the openings of dewatering outlets, diversion out-lets of concrete dams, head walls equipped with projecting piers such as the head wall of the diver-sion tunnel of a hydrostation and head walls of closed conduit offtake regulators of irrigation and drainage systems. (Baker-IVI)
W85-00483

OPTIMIZATION OF THE FILLING AND DRAWDOWN REGIMES OF A REGULATING RESERVOIR OF THE KUBAN' CASCADE, For primary bibliographic entry see Field 3B. W85-00485

PARAMETERS OF LOCAL SCOUR IN THE REGION OF A SINGLE CYLINDRICAL PIER AND FACTORS DETERMINING THEM, N. D. Kanarskii.

N. D. Kanarskii. Hydrotechnical Construction, Vol. 17, No. 9, p 457-462, September, 1983. 3 Fig. 11 Ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 30-34, September, 1983.

Descriptors: *Scour, *Fluid mechanics, *Piers, Flow, Bridges, Towers, Foundations, Stability, Soil types, Velocity, Bed erosion.

Causes of the formation of local scouring near structures of the pier type have been investigated. They appear to be caused by two types of separation: three-dimensional, producing scour proper; and two-dimensional, a consequence of which is sucking of the soil scour particles into the low presssure zone behind the body. An analysis of the phenomenon of local scour in the region of a single cylindrical pier with the use of methods of similarity and dimensional theory made it possible to establish the form of the dimensionless equations determining the noneroding velocity and dimensional the control of the dimension of the control of determining the noneroding velocity and dimen-sions of the scour pocket near the pier. Formulas were obtained for determining the noneroding ve-locity and for the parameters of local scour which are valid for conditions of medium and coarse grained sands and circular cylindrical piers. (Baker-IVI) W85-00493

8C. Hydraulic Machinery

GUIDELINES FOR EFFICIENCY SCALING PROCESS OF HYDRAULIC TURBOMA-CHINES WITH DIFFERENT TECHNICAL ROUGHNESSES OF FLOW PASSAGES,

Technische Hochschule, Darmstadt (Germany,

J. Osterwalder, and L. Hippe. Journal of Hydraulic Research, Vol. 22, No. 2, p 77-102, 1984. 22 Fig, 14 Ref.

Descriptors: *Pumps, *Turbines, *Scale effects, *Hydraulic roughness, *Model studies, Pumped storage, Corrosion, Mechanical equipment.

Pumps and turbines of radial to semi-axial flow are considered. Such pumps are frequently used in water power and pumped storage plants. The scaling process as described is known in the literature and is presented in an abridged form in an easily intelligible way. To simplify practical application, clearly set out diagrams are used which permit a quick determination of efficiency scaling. The fundamental laws are briefly reviewed with reference to the relevant bibliography in order to provide a better understanding. Of particular interest is the relation between the efficiency loss due to roughness and an economically justifiable extent of surreaston between the efficiency loss due to fougn-ness and an economically justifiable extent of sur-face finishing of flow passages. Another important criterion is the surface roughness characterized by the term hydraulically smooth. Relevant numerical data can easily be determined on the basis of suitable diagrams. (Baker-IVI) W85-00194

DYNAMIC RESPONSE OF CHECK VALVES, City Univ., London (England). Thermo-Fluids Enering Research Center. gineering Re D. Thorley.

Chemical Engineer, Vol. 402, p 12-15, April, 1984.

Descriptors: *Valves, *Testing, *Check valves, Mechanical equipment, Design criteria.

The important features of good check valve design are deduced and criteria for selecting low-loss, non-slam valves are suggested. For arduous conditions of service such as those associated with high head, multi-pump duty it is suggested that in the interests of avoiding check valve slam the following criteria should be applied when selecting a suitable non-return valve: low inertia of the moving parts; short travel distance/angle and; airor coil-spring assistance of closure, commencing at about 70% of the rated flow. Further controlled tests are needed to compare different valve types having previously tuned each one to give its optimum performance in the selected test facility. (Baker-IVI) W85-00199

EVALUATING AND IMPROVING EXISTING GROUND-WATER SYSTEMS,

California Univ., Davis. Dept. of Civil Engineer-

For primary bibliographic entry see Field 4B.

Hydraulic Machinery—Group 8C

TECHNOLOGICAL DEVELOPMENT OF GATED WEIRS ON NAVIGABLE WATER-WAYS (EVOLUTION TECHNOLOGIQUE DES BARRAGES MOBILES SUR LES VOIES NAVI-GARLES).

M. A. Petitiean

Houille Blanche, No. 2/3, p 141-144, 1981. 3 Fig.

Descriptors: *Navigable waters, *Waterways, *Weirs, Reviews, Barriers, Dams, Gates, Design criteria, Construction, Hydraulic engineering, Sluices, Sluice gates.

A brief historical review of technical develop ments dealing with navigable waterways is offered ments dealing with navigable waterways is offered.

During the past ten years two particular types of
weir were most frequently employed on waterways. These were: flap-gate weirs (economical for
sluice widths up to 30 m and gates less than 5 m
high); and segment gate weirs with or without an
overspill flap (for gate heights over 5 m but sluice
widths only up to 20 m). Each type of closure is
considered for its necticular advantages and disedwindins only up to 20 m). Each type of closure is considered for its particular advantages and disadvantages and various design improvements of each over the past decade are reviewed. Other technological developments are briefly noted including emergency stoplogs, fixed components, construction methods and automation. (Baker-IVI)

CONSTRUCTION OF A GATED WEIR ON A WATERWAY CARRYING HEAVY TRAFFIC (CONSTRUCTION D'UN BARRAGE MOBILE SUR UNE VOIE NAVIGABLE A FORT SUR UN TRAFIC),

R. Lefoulon.

Houille Blanche, No. 2/3, p 145-148, 1981. 2 Fig.

Descriptors: *Navigable waters, *Waterways, *Weirs, *Marckolsheim Barrage, *Rhine River, Construction, Design criteria, Hydraulic engineer-

Construction stages for the Marckolsheim barrage on the Rhine River are reviewed. Out of difficulties which arose during this engineering project, several changes in construction methods were instituted during the construction of the next bar-rage, built at Rhinau. As these changes proved to be satisfactory, particularly for navigation require-ments, they have since been adopted into the standard practices for barrages built downstream from Rhinau. These changes make the gated weir particularly suitable for any navigable waterway carrying heavy traffic. (Baker-IVI) W85-00376

GATED WEIRS: TECHNOLOGICAL DEVEL-OPMENTS AND AUTOMATION (LES BARRAGES MOBILES, EVOLUTION TECHNOLO-GIQUE ET AUTOMATISATION),

Houille Blanche, No. 2/3, p 149-150, 1981.

Descriptors: *Waterways, *Weirs, *Automation, Computers, Navigable waters, Gates, Hydraulic engineering, Planning, Decision making, Flow, Waves, Stability.

All possible operating conditions were taken into account during the design stages for the automatic control equipment at the Rhone River development sites, each of which is equipped with gated weirs. This includes from low water conditions to the highest known high water discharges. Automatics did not stated in the conditions to the highest known high water discharges. Automatics did not stated in the state of the conditions to the highest water and the state of the s tion did not entail any major technological changes except in those instances where operating relia ity needed to be improved. It is suggested that close attention be given to situations in which weir operation is controlled by computer. When programming automatic control equipment particular attention must be given to hydraulic problems such as flow, waves, and stability. In order to ensure accurate adjustment, particularly under transient conditions, it is usually essential to have available extensive major hydraulic measurements. (Baker-W85-00377

IMPACT LOADS OF SHIPS ON STRUCTURES (PROBLEMES DES CHOCS DE BATEAUX SUR

P. Dubois, P. Cornier, J. Mamet, and M. Corbic. Houille Blanche, No. 2/3, p 159-168, 1981. 12 Fig.

Descriptors: *Locks, *Safety, *Impact load, *Ships, Rhone River, Navigable waters, Waterways, Regulations, Piers, Hydraulic engineering.

Safety equipment used in the Compagnie Nationale du Rhone locks is reviewed. Systems for stopping downstream-bound boats in the bottom of locks are described. Such a need arose with the coming of a new generation of boats using the Rhone, including pusher units in 1975 and river/sea freighters in 1978. Brief descriptions are offered of techniques applied for locks at Bollene, Montelimar, Sablons, Vaugris and Avignon. Local river traffic conditions played a large part in designing the pier seatings and foundations of bridges across diversion canals of the Rhone. In harbor areas bridges were designed with allowance for possible diversion canals of the Rhone. In harbor areas bridges were designed with allowance for possible pier impact loads as under current regulations. On sections possibly carrying traffic, bridge design of piers was done according to probable traffic, with provision for subsequent addition of impact protection equipment. A description is included of a study by the Institut de Recherches de la Construction navale, prepared for the French Transport Ministry's Service Central des Ports Maritimes et des Voies Navigables to determine the impact load of a pier hit by a ship. (Baker-IVI) w85-00379

MICRO HYDROELECTRIC STATIONS WITH POWERS UNDER 100 KW (MICROCEN-TRALES HYDROELECTRIQUES D'UNE PUIS-SANCE INFERIEURE A 100 KW).

Houille Blanche, Vol. 36, No. 4/5, p 249-257, 1981.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Turbines, Electric power production, Hydraulic turbines, Kaplan turbines.

In order to respond to the growing demand for low-power micro hydroelectric stations, the firm Leroy Somer has developed the HYDROLEC range of micro stations. These hydroelectric sets comply with two essential objectives: simplicity and reliability. Their design simplifies problems of installation, use, and maintenance. The range covers heads of one to 25 m and turbined flows of 100 to 2500 L/s; the electrical powers per unit vary according to the type from between two to 50 vary according to the type from between two to 50 kW. The installed power can be multiplied by placing several microstations in parallel. In the standard version, the sets deliver three-phase low-voltage AC current: 380 V at 50 Hz or 460 V at 60 V. Voltage AC current: 380 V at 30 Hz 20 r 400 V at 60 U. 21 Mz. The sets form a single block; their reduced weight and volume simplify transport and installation. They use Kaplan turbines with blades adjustable when stationary. Continuous control of flow is obtained by manual alteration of blade angle. Series H units (one to 10 m of head, two to 50 kW) Series H units (one to 10 m of nead, two to 20 kW) are compact hydroelectric sets that operate submerged in the downstream spillway channel. This arrangement offers numerous advantages; there is no superstructure and they are unaffected by flood conditions and the prevailing weather. The whole the desirant with operating weather. The whole tried technologies; parts are calculated for a working life of 100,000 hours, and maintenance is virtually zero. The set can be installed in any position, behind a power penstock or directly in a water chamber. (Author's abstract) is designed with continuous concern for simplicity and reliability; the construction is robust using

RECOVERY OF HYDRAULIC ENERGY: SMALL INSTALLATIONS ASSOCIATED WITH MAJOR HYDRAULIC PROJECTS (RECUPER-ATION D'ENERGIE HYDRAULIQUE: PE-TITES INSTALLATIONS D'ENERGIE ASSO-CIEES A DE GRANDS PROJETS HYDRAULI-

J. P. Rouyer, and C. Le Plomb. Houille Blanche, Vol. 36, No 4/5, p 259-268, 1981.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *France, Electric power production, Economic efficiency, Energy recovery, Economic aspects, Navigation dams, Return flow.

aspects, Navigation tams, Return flow.

Economic and technical aspects of energy recovery, which is the alternative to simple discharge of the reserve flow in major hydraulic projects, are examined. New small, low cost installations linked to existing equipment have become economically justified; the projects of Electricite de France (EDF) and Compagnie Nationale du Rhone (CNR) represent a production of 280 million kWh and a power of nearly 50,000 kW. Illustrations of recent EDF developments are: the Strasbourg return plant (1MW, 8 GWh); the return plant at Nepes, downstream of the St. Etienne Cantales dam (2.8 MW, 8.7 GWh); and the project for equipping the navigation dams on the Moselle (32 MW, 180 GWh). Recent CNR developments are Chautagne (2 sets, 1.6 MW, 9.6 GWh/y); Belley (1 set, 0.7 MW, 4.8 GWh/y); Brejier Cordon (2 sets, 4.4 MW, 33.8 GWh/y); St. Pierre de Boeuf; Lavours; Charmes; and Pierre Benite. (Collier-IVI) W85-00383

THERMAL ENERGY FROM THE SEA: STATIONS USING THE CLOSED THERMODYNAMIC CYCLE (ENERGIE THERMIQUE DES MERS: LES CENTRALES A CYCLE THERMODYNAMIQUE FERME),

Houille Blanche, Vol. 36, No. 4/5, p 323-330, 1981. 11 Fig. 1 Tab.

Descriptors: *Thermal energy, *Seawater, *Tahiti, Heat transfer, Thermodynamics, Electric power-plants, Hydraulic machinery, Site selection, Water

In intertropical regions, the surface of the sea is at a temperature of about 28 C. At depths of about 1000 m, the water temperature is about 4 C. The surface water to a depth of 20 or 30 meters represented. sentiace water to a depth of 20 or 30 meters represents an immense reserve of stored solar energy. A closed cycle thermodynamic energy plant designed for Tahiti is evaluated. Closed-cycle stations on land sites are found to be perfectly feasible. The cold-water conduit constitutes a very important element in the system. The hydraulic problems posed by its siting are described in principle. (Moore-IVI)

HYDRAULIC PROBLEMS POSED BY DIRECT-CYCLE TES STATIONS OFFSHORE (PROBLEMES HYDRAULIQUES POSES PAR LES CENTRALES ETM A CYCLE DIRECT AU LARGE).

ELINUELY, Societe Grenobloise d'Etudes et d'Applications Hydrauliques (France). M. F. Gauthier, and J. Zaoui. Houille Blanche, Vol. 36, No. 4/5, p 331-333, 1981.

Descriptors: *Hydraulic equipment, *Offshore, *Powerplants, *Thermal energy, Heat transfer, Electric power production, Floating powerplants.

For an open-cycle floating thermal-energy from the sea (TES) power station, the hydraulic prob-lems involve three aspects: the conditions for aspi-ration of hot and cold sources and the risks of recirculation; the internal hydraulics of circuits installed on a mobile platform and the coupling of the different circuits; and the influence of sea con-ditions. These three problems are presented and ditions. These three problems are presented and the specific aspects of this type of project under development by the CGE-Alsthom-Atlantique-ETPM Group are discussed. (Author's abstract) W85-00386

EFFECT OF OPERATING HYDRAULIC TURBINES AT LOW HEADS ON WEAR OF BLADING ELEMENTS, __

N. N. Kozhevnikov.

Hydrotechnical Construction, Vol. 16, No. 1, p 40-43, January, 1982. 3 Fig, 5 Tab, 3 Ref. Translated

Field 8—ENGINEERING WORKS

Group 8C-Hydraulic Machinery

from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 37-40, January, 1982.

Descriptors: *Turbines, *Low head, *Wear, Cavitation, Hydraulic equipment, Pressure head, Vibra-

When solving the problem of starting up units at head substantially lower than the minimum permis-sible with respect to cavitation conditions, it is necessary to perform a power and economic analy-sis to select the most rational variant, such as the sa to select the most rational variant, such as the use of permanent or temporary runners, permanent generators at the rated rotational speed or temporary ones with a reduced speed. The indicated analysis should take into account the duration of operation of the units at low heads, the expected rate of cavitation erosion, vibration of the supporting parts of the unit as a consequence of increased ing parts of the unit as a consequence of increased pressure fluctuations in the flow, and other factors affecting the selection of the optimal variant. affecting the

PROBLEMS OF RELIABILITY OF MECHANI-CAL EQUIPMENT OF HYDRAULIC STRUC-TURES, I. V. Martenson

Hydrotechnical Construction, Vol. 16, No. 2, p 56-58, February, 1982. Translated from Gidrotekhni-cheskoe Stroitel'stvo, No. 2, p 10-11, February,

Descriptors: *Mechanical equipment, *Design criteria, Monitoring, Prediction, Reliability, Gates.

When designing mechanical equipment such as gates for hydraulic structures it is necessary to take into account not only the one-time expenditures on its production and assembly but also its operational reliability, maintenance, annual costs for upkeep and repair of equipment, labor efficiency, and working conditions of the operating personnel. One way to increase the reliability of mechanical equipment is to develop standard criteria of its condition, such as longevity, technical life, no-failure operation, maintainability, etc., which permit a confident determination of the actual reliability indices and prediction of its operational capability. For developing the criteria, determining numerical reliabily indices of operating equipment, and determining the regularities of the change of these indices with time or as a function of the actual cumulative operating time of the equipment, actual cumulative operating time of the equipment, it is necessary to generalize the available data and collect missing data on the actual condition of mechanical equipment, its operation, and repair. To increase the quality of evaluating the technical condition of mechanical equipment it is necessary to develop on the basis of technical diagnostic to devetop on the basis of technical diagnostic principles a method of evaluating the actual condition of equipment and instructions on predicting its further operational capability. It is necessary to design portable diagnostic and monitoring and measuring equipment for conducting inspections in a volume sufficient for an objective evaluation of the condition and for predicting the actual reliability indices of mechanical equipment. (Baker-IVI) W85-00434

CHARACTERISTICS OF THE OPERATION OF THE MECHANICAL EQUIPMENT OF THE DAM OF THE KRASNOYARSK-2 HYDRO-ELECTRIC STATION, S. V. Seleznev, S. M. Klimov, and O. B. Vaulina. Hydrotechnical Construction, Vol. 16, No. 2, p 101-104, February, 1982. 1 Fig. 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 38-40, February, 1982.

Descriptors: *Mechanical equipment, *Design criteria, Dam construction, Spillways, Hydroelectric plants, Gates, Ice.

On the basis of experience gained in the operation of the mechanical equipment of a hydroelectric station dam, a number of recommendations are made which could be beneficially taken into account when designing analogous hydrostations. For hydrostations with a small storage capacity of the reservoir located under harsh climatic condi-

tions it is often necessary to provide for the possi-bility of passing ice through spillway outlets of the dam and to take into account dynamic ice loads when designing mechanical equipment. For repair-ing the spillway part of the dam it is expedient to ing the spillway part of the dam it is expedient to use caisson gates, and for newly designed hydrostations to provide for fixed parts of the guard gate. Low-cycle fatigue and stress concentration can be one of the possible causes of destruction of the gates. The existing methods of determining the load on the wheel supports of the service gates give a sufficient margin ensuring their long-term operation. The method of determining the load on the side guides of the gates with two points of suspension requires correction. It is recommended that a gantry crane he provided for servicing the suspension requires correction. It is recommended that a gantry crane be provided for servicing the mechanical equipment of overflow dams having two or more outlets. (Baker-IVI) W85-00438

ASSEMBLY OF THE PENSTOCKS OF THE SHAMBA HYDROELECTRIC STATION,

G. A. Polonskii. Hydrotechnical Construction, Vol. 16, No. 3, p 115-122, March, 1982. 5 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 2-6, March, 1982.

Descriptors: *Penstocks, *Design criteria, Pipelines, Materials, Steel, Hydroelectric plants,

The Shamba hydroelectric station is the second reach of the Vorotan series of hydroelectric stations. The pressure conduit of the Shamba hydrostation starts from an intake located in the Toloros reservoir. From the reservoir the water flows into a single line diversion pipeline and penstock. Sev-eral progressive technical procedures were used in eral progressive technical procedures were used in the construction of the facility. A decrease in the consumption of metal due to using high-strength steel in the manufacture of the pipes saved 300 tons of steel. The designed 'fs and 's provided a minimum number of assembly units and thereby increased the technological efficiency in the manufacture and assembly of the pipe. The technology for assembling pipes in a 212 m deep vertical shaft and in horizontal tunnels with a small annular was developed for the first time. Self-propelled mechanisms, which made it possible not only to deliver links to the assembly site over a distance of 1.5-2 km, but also to adjust them for assembly, were used for the first time. The pipe was assembled in used for the first time. The pipe was assembled in the 212-m vertical shafts by means of a 40/10 ton gantry crane, and emergency and construction hoists, which provided complete safety of the works. Newly developed suspended platforms were also used for the vertical shaft instead of labor intensive, material consuming scaffolding over the entire height of the shaft. (Baker-IVI) W85.00430

EFFECT OF THE OUTLET ANGLE BETA-2 ON THE CHARACTERISTICS OF LOW SPECIFIC-SPEED CENTRIFUGAL PUMPS,

Hydrotechnical Construction, Vol. 16, No. 5, p 267-273, May, 1982. 13 Fig. 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 21-25,

Descriptors: *Pumps, *Design criteria, *Centrifugal pumps, Pumping plants, Hydraulic equipment.

An increase of head, delivery, and efficiency of pumps promotes a decrease in the ude of metal, electric power, and floor space of pumping stations. For low specific-speed pumps, changing the geometry of the vaning of the impeller increases the head considerably without a decrease of pump efficiency. The major feature changed is the outlet angles of the vanes which are increased to values where 90 decreases of the values of the valu where 90 degreess < or = beta-2 < or = 130 degrees. Short intermediate vanes are installed in uegrees. Snort intermentate vanes are installed in the passages between the main vanes. For centrifu-gal pumps with a volute end diffuser whose impel-lers have a different number of main vanes, the most rational move is to install three intermediate vanes in each vane passage with a change in the direction of the flow by the main vane toward an increase of the outlet angle on diameter D2 for

fecal pumps and pumps with short vanes. The use of the new impeller design is particularly effective for high rotative-speed pumps. For multistage submersible pumps with a guide vane apparatus at the inlet and axial outlet, the optimal variant is the inlet and axial outlet, the optimal variant is the installation of one intermediate vane with a start of the change in the flow direction. All tests were conducted without modifying the casing and branch pipes, which leaves room for a further increase of the head developed by pumps with the new type of impeller. (Baker-IVI) W85-00460

8D. Soil Mechanics

VALIDITY OF DENSITY-LIQUID LIMIT PRE-DICTIONS OF HYDROCOMPACTION, Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region. N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol. 21, No. 2, p 191-205, May, 1984. 13 Fig, 4 Tab, 30 Ref.

Descriptors: *Compaction, *Hydrocompaction, *Density-liquid limit, *San Joacquin Valley, *California, Stability, Soil properties, Subsidence.

fornia, Stability, Soil properties, Subsidence.

Hydrocompaction, which can cause severe damage to canals, dams, pipelines, roads, and buildings, is one of the most destructive forms of subsidence. The reliability of density-liquid limit for delineating between stable areas and areas potentially susceptible to hydrocompaction is investigated. The evaluation was based on some 10,700 samples obtained from more than 1,100 test holes in the west-central part of the San Joaquin Valley in California. The apparently logical and simple density-liquid limit method for prediction of areas susceptible and nonsusceptible to hydrocompaction yields nonreliable results. The method should not be used for practical engineering purposes in this area. The validity of the method in other areas should be carefully verified prior to usage. The poor reliability of the method can be attributed to either the poor quality of field and laboratory data or to mistaken theoretical assumptions. The basic assumption of the method is that susceptibility to hydrocompaction requires the pore volume of undisturbed sediments to be large enough to hold the volume of water needed to bring the sediments to the liquid limit condition. (Baker-IVI) W85-00136

PREDICTIONS OF FUTURE SUBSIDENCE ALONG FRIANT-KERN CANAL IN CALIFOR-

Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.

CA. Mulracine Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol. 21, No. 2, p 215-228, May, 1984. 15 Fig. 1 Tab, 16 Ref.

Descriptors: *Subsidence, *Canals, *Construction, *Friant-Kern Canal, *California, Prediction, Canal rehabilitation, Groundwater level, Tectonics,

The Friant-Kern Canal is 244.3 km long, mostly concrete lined, and formed an early key facility of the Central Valley Project of the Bureau of Reclamation. The Canal extends from Friant Dam to the mation. The Canal extends from Friant Dam to the Kern River near Bakersfield in the southeastern part of the San Joaquin Valley in California. The diversion capacity is 170 cu m/sec. About 48.3 km of the alignment, between mileposts 95 and 125 are on the periphery of the major Tulare-Wasco sub-siding area. Postconstruction subsidence within the reach locally exceeded 1.5 m. The exact causes of reach locally exceeded 1.5 m. The exact causes of subsidence along the canal are not known. Most is probably caused by a distant irrigational overdraft of confined ground water aquifer systems. Tectonic movements are also possible. In general the postconstruction ground water levels along the canal are rising. In 1976-77 interference from subsidence caused a 26.67 km long reach of the canal to be rehabilitated. Also necessary was the raising of three subsided pumping plants in 1979-81, at a total cost of about \$4,700,000. While the quality of

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future levelings along the canal is doubtful due to the apparent instability of reference bench marks, it is recommended that systematic measurements of depth of water be conducted at check structures and selected bridges in the standstill canal. In 1979-80 such measurements indicated the possibility of some local tectonic uplift and downwarp. Although the existence of land subsidence along the Friant-Kern Canal was realized during its construction, apparently no design modification to compensate for future subsidence was made at that time. Continuous construction-postconstruction compensate for tuture subsidence was made at that time. Continuous construction-postconstruction subsidence along the canal locally exceeded 1.37 m, and eventually interfered with normal canal operation and maintenance. The approximate cost of canal rehabilitation to the present time has been about \$4,700,000. (Baker-IVI)

STRESS-DEFORMATION PREDICTIONS FOR THE LG 4 MAIN DAM, Societe d'Energie de la Baie James, Montreal (Quebec). J. J. Pare, N. S. Verma, H. M. S. Keira, and A. D.

McConnell. Canadian Geotechnical Journal, Vol. 21, No. 2, p 213-222, May, 1984. 12 Fig, 1 Tab, 7 Ref.

Descriptors: *Stress analysis, *Rockfill dams, *Deformation, *Quebec, *La Grande River, Earth dams, Abutments, Strain, Hydraulic fracturing, Arching, Dam design, Curvature.

The main dam at LG 4 is situated 463 km from the mouth of the La Grande River in the James Bay territory, northern Quebec, about 1000 km from Montreal. The dam is composed of 19000000 cu m Montreal. The dam is composed of 19000000 cu m of fill materials. The design of the dam is characterized by a zoned earth-rockfill section based on a judicious use of the limited quantities of various materials available, a 70 m high abutment in the river valley with a steep inclination of about 55 degrees, and a 50 m high section of the dam with degrees, and a 50 m high section of the dam with stax is curved in the downstream direction. Detailed stress-deformation analyses were carried out in the critical sections of the dam using finite element methods to verify any presence of arching and hydraulic fracturing potentials in the nonplastic till core. The analysis indicated that only minor arching may be expected between the core and the adjacent sand and gravel zones, especially in view of the modified compaction requirements. The radius of curvature of 700 m of the dam axis in the secondary valley is sufficient to avoid adverse effects of downstream curvature on the tangential stresses in the core. Near the steep abutment, although no arching is indicated in terms of the distribution of the major principal stress, some weakness is indicated by the reduction of the minor principal stress within the plane of the longitudinal section. The simple analytical approach has been satisfactory in providing the answers to the question related to the performance of the dam in the critical areas of zone interfaces, steep abutments, and reverse curvatures. (Baker-IVI) its axis curved in the downstream direction. De-

HORIZONTAL DRAINS TO STABILIZE CLAY SLOPES

Toronto Univ. (Ontario). Dept. of Civil Engineer-

ing. K. C. Lau, and T. C. Kenney.

Canadian Geotechnical Journal, Vol. 21, No. 2, p 241-249, May, 1984. 10 Fig. 11 Ref. National Sci-ences and Engineering Research Council of Canada grant A4543, Ministry of Natural Re-sources, Ontario, grant GR-7.

Descriptors: *Drainage systems, *Slope stabiliza-tion, *Clay, Slopes, Stability, Permeability, Soil properties, Slope stability, Piezometry, Hydraulic boundary.

Five horizontal drains were installed in a natural clay slope and the piezometric heads in the slope were monitored with piezometers. The measured reductions of piezometric levels at the test site caused by the installation of horizontal drains dem-onstrate that horizontal drains can be used to im-prove the stability of clay slopes. In clay soils having small values of coefficient of consolidation

the piezometric levels at depths greater than about 7 m below the ground surface are stable and are insensitive to changes of hydraulic conditions at the ground surface. It follows that reductions of piezometric levels at these and greater depths due to horizontal drains may be considered as permanent reductions that are independent of precipitation and other climatic events. Estimates were made of changes of piezometric level resulting from installation of horizontal drains based on consolidation theory, the computer program TRUST, soil properties, and hydraulic boundary conditions determined through field measurements. Comparisons between estimated and measured values showed good agreement, indicating that the method of prediction is sufficiently reliable to use for design. The effectiveness of horizontal drains to improve the stability of clay slopes depends on drain spacing, drain diameter, and drain location with respect to the critical slip zone. It also depends on the drains remaining pervious to groundwater, a subject not investigated in this study. Most slopes have different soil hydraulic and geometric characteristics and therefore the design of drainage systems to improve slope stability should be done on an individual basis. (Baker-IVI)

HORIZONTAL FROST HEAVE THRUST ACTING ON BUTTRESS CONSTRUCTIONS, Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology. T. Changjian, and S. Zongyan. Engineering Geology, Vol. 18, 259-268, 1981. 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Frost heaving, *Frost thrusting, *Soil water, *Buttresses, Soil temperature, Freezing, Silt, Clay.

In cold regions, many buttress constructions suffer from inclination, horizontal displacement, cracking, shear fracture, and concave sinking of the foundations due to the freezing of the soil and rick which have been retained by these constructions. From the results of measurements at actual engineering sites and from model tests in the laboratory, it is clear that (at the time of freezing) the horizontal frost heave force of the the soil body at the restraining wall is quite large. Its amplitude is closely related to the material composition and the water content of the infilling soil body, and also to the degree of deformation of the construction. When the water content of the soil is less than its plastic limit, the horizontal frost heave thrust increases with increasing water content of the soil is greater than its plastic limit, the frost heave thrust increases with increasing water content and when the water content is a little over its liquid limit, it reaches a maximum value. The horizontal frost heave the water of ceil in value. tent and when new water content is a little over its liquid limit, it reaches a maximum value. The horizontal frost heave thrust of soil varies with temperature; it increases as the temperature falls, until it reaches a maximum value at about -7 degrees C. The distribution of the horizontal frost heave thrust along the lateral surface of the structure is not always uniform; its value is greatest at the middle, less at the bottom, and least at the top. middle, less at the bottom, and least at the top. Frost heave thrust varies according to the content of fine silt clay particles. The higher its content, the greater the horizontal frost heave thrust. The maximum value generally appears at the place where the depth is about 60-80% of the depth of frost penetration. The amplitude of horizontal frost heave thrust has minimum values of 0.3-0.4 kg/sq cm, but it is generally between 1-3 kg/sq cm, with maximum values between 4.1-4.2 kg/sq cm. (Moore-IVI) W85-00274

DESIGN CONSIDERATIONS FOR EARTH LININGS FOR SEEPAGE CONTROL,
Agricultural Research Service, Phoenix, AZ.
Water Conservation Lab.

Ground Water, Vol. 20, No. 4, p 531-537, September-October, 1982. 6 Fig, 13 Ref.

Descriptors: *Linings, *Earth linings, *Seepage control, *Design criteria, Pond liners, Channel liners, Permeability coefficient, Head, Unsaturated flow, Clay, Wastewater ponds, Water pollution

Darcy's equation and unsaturated-flow theory are used to calculate flow through earth linings that are placed in ponds or channels to reduce seepage. The procedure utilizes the relation between unsaturated hydraulic conductivity and pressure head of the underlying material as calculated from the measured saturated hydraulic conductivity and the measured saturated orderation conductivity and the relation between water content and pressure head. The method enables the selection of the liner (thickness and hydraulic conductivity) that will keep seepage below a certain maximum limit. Since the hydraulic conductivity of clays is affected by the hydraulic conductivity of clays is affected by the cationic composition and the salt concentration of the soil solution, the chemical composition of the liquid moving through the liner must be taken into account. This applies also to other chemicals, including solvents and other organic compounds that may be in the water. Travel times of water from the surface impoundment to the underlying ground water are calculated from the seepage rate and the corresponding water content in the vadose ground water are calculated from the seepage rate and the corresponding water content in the vadose zone. Accumulation of solids (mine tailings, for example) can further reduce the seepage from the pond. Proper design of wastewater ponds also requires analysis of the response of the underlying ground water (mound buildup) and the movement of pollutants in the vadose zone and aquifer. In view of the high costs of earth liners, prediction of the seepage is necessary to make sure that the selected lining material, the thickness of the liner itself, and the method of construction will produce the desired results. (Author's abstract)

CALCULATION OF THE EFFECT OF SEISMIC LOADS ON EARTH DAMS BY THE LINEAR SPECTRAL METHOD,
A. P. Troitskii, and S. C. Shul'man.

Hydrotechnical Construction, Vol. 16, No. 1, p 13-20, January, 1982. 8 Fig. 3 Tab, 17 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p

15-20, January, 1982.

Descriptors: *Earth dams, *Dam stability, *Linear spectral method, *Seismic load, Soil properties, Dam foundations, Dam construction, Design crite-

Certain basic stages of the linear spectral method are examined for calculating various types of earth dams. Attention is given to the considerations of nonlinear deformability of the material, the effect of the foundation, and the saturation of soil of the dam. The calculation schemes and corresponding numerical results show that the available information of the saturation of soil of the dam. ition on the properties of soil materials and methods of calculation permit evaluating the seismic stability of earth dams within the scope of the standard method with approximate consideration of the most characteristic features for such structures. (Baker-IVI) W85-00429

USE OF WEAK ROCKS IN DAM CONSTRUCTION ABROAD.

For primary bibliographic entry see Field 8E. W85-00433

CALCULATION OF THE THREE-DIMENSIONAL STRESS-STRAIN STATE OF AN EARTH-ROCK DAM,

For primary bibliographic entry see Field 8A. W85,00436

DEVELOPMENT OF A MANUFACTURING METHOD FOR PRECAST ELEMENTS OF RE-INFORCED-CONCRETE PIPES OF THE ZA-GORSK PUMPED-STORAGE STATION USING ELECTRIC HEATING OF THE CONCRETE MIX.

na, A. D. Osipov, V. V. Slozhenikin,

N. V. Yudina, A. D. Osipov, V. V. Sioznemikin, and T. M. Davydova. Hydrotechnical Construction, Vol. 16, No. 3, p 126-131, March, 1982. 4 Fig. 2 Tab, 4 Ref. Trans-lated from Gidrotekhnickeskoe Stroitel'stvo, No. 3, p 10-12, March, 1982.

Field 8—ENGINEERING WORKS

Group 8D—Soil Mechanics

Descriptors: *Pipes, *Pumped storage, *Concrete, *Heat treatment, Steel, Reinforced concrete, Precast concrete, USSR.

Construction of the steel and reinforced-concrete pipes of the Zagorak pumped-storage station having an inside diameter of 7.5 m and total length of 5 km is supposed to be accomplished in a precast variant. The precast elements of the pipes - rings 4.4 m long - will be maunfactured in a casting yard located near the site of the pipelines and equipped with a 200-ton-capacity crane. The volume of concrete of the ring is 44 c m. It is manufactured in a vertical position. Electric heating of the concrete mix in buckets immediately before pouring the concrete into the mold with subsequent aging of the ring formed from the host mix until it acquires installation strength, is adopted as the main method of heat treatment of the precast elements. Experiments with additive-free mixes showed that after heating at a temperature above 40 degrees these ments with additive-free mixes showed that after heating at a temperature above 40 degrees these mixes set during aging for 2 hr. The duration of their vibration to a dense state far exceeded the prescribed time of 30 sec. This was grounds for rejecting the use of the additive free mixes in combination with electric heating. The results of investigations of heat treatment with the use of a hot concrete mix and also further development of this method under production conditions will form the basis of the appropriate section of the technical specifications for the manufacture of precast elements of pipes of the Zogorsk RSS. (Baker-IVI) W85-00440

OPERATING CONDITIONS OF EARTH DAMS ON UNDERMINED TERRITORIES, V. I. Teleshev, V. F. Markevich, and G. Ya.

Hydrotechnical Construction, Vol. 16, No. 3, p 149-155, March, 1982. 4 Fig. 1 Tab, 14 Ref. Trans-lated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 23-26, March, 1982.

Descriptors: *Dam construction, *Earth dams, *Undermining, Safety, Dam stability, Dam foundations, Deformation, Design criteria.

The operating conditions of a dam on undermined territories substantially differ from those under ordinary conditions without undermining. This necessitates a special approach to the design and operation of such dams, since the use of the experience of conventional hydraulic engineering is not possible. The occurrence of cracks in the foundation in the case of undermining unloads the solimans adjacent to them. Further deformation of the mass adjacent to them. Further deformation of the mass occurs due to an increase in the size of the primary cracks, practically without the occurrence of new ones, which is the main characteristic of deformation of earth dams on undermined territories. The use of nonsoil materials for watertight elements (WTE) of dams cannot completely eliminate and cannot change the regular mechanism of cracking in their body; consequently disruption of the continuity of such elements is possible. The use of the indicated nonsoil materials as WTE, in principle, requires further study. (Baker-IVI) W85-00443

EXPERIENCE IN CONSTRUCTING RADIAL WELLS IN FINE SANDS,

WELLS IN FINE SANDS, V. E. Anpilov, Yu. V. Ponomarenko, V. P. Lugovoi, V. S. Kuz'kin, and F. S. Malatskovskii. Hydrotechnical Construction, Vol. 16, No. 3, p 178-181, March, 1982. 3 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 50-52, March, 1982.

Descriptors: *Drainage, *Test wells, *Sand, Drilling, Construction, Silt, Wells, Soil properties, Per-

Industrial tests were performed of radial drainage on the subirrigated grounds of a mining and concentration plant composed of fine sands not only to determine the effectiveness of the method for draining sands, but also to develop the technology of drilling radial wells in sands and equipping the wells with filters to expand the area of their useful-ness. The area was composed of inhomogeneous fine sands containing discontinuous layers and

lenses of yellow-gray and light-gray compact clay with a thickness from 0.4 to 5.0 m. Ferruginous sandstone interlayers were found in the fine sands. The sands are deposits of large rivers, oxbows, and near channel lakes. The silt fraction in the sands was not constant, varying from 0.5 to 25.5%, averaging 10.2%. Thickness of the fine sands vaired from 6-10 to 15-19 m, the permeability coefficient varied from 0.5 to 2-8 m/day. Favorable drainage results were obtained. (Baker-IVI) W85-00447

PROSPECTS OF IMPROVING METHODS OF CONSTRUCTING FROZEN-TYPE EARTH DAMS,

ov. V. I. Makarov, and A. A.

Plotnikov. Hydrotechnical Construction, Vol. 16, No. 5, p 239-245, May, 1982. 3 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 5-9, May, 1982.

Descriptors: *Dam construction, *Frozen ground, *Earth dams, Arctic zone, Freezing, Construction, Hydraulic engineering, Soil water.

Current technology for constructing frozen-type dams insufficiently takes into account the use of the natural conditions found in the Far North. The the natural conditions found in the Far North. The basic difference between frozen and thawed dams is that seepage is not permitted through the body and foundation of such dams. This is achieved by artificial freezing of the soils in the dam core with the mandatory condition that the frozen cutoff wall in the core be interlinked with the permanently frozen soils in the foundation. It is suggested that the soil, before freezing, be saturated with water until all pores are filled, contrary to current practices. However, an increase of the soil moiswater until all pores are filled, contrary to current practices. However, an increase of the soil moisture content does hamper its artificial freezing. To freeze saturated soil it is expedient to construct watertight elements from lumps of cooled frozen soil placed as layers by drenching with water and allowing natural freezing of the layers by turns. Any local soil may be used and the natural cold becomes a constructive factor, thus reducing costs. becomes a constructive factor, thus reducing costs. The possible rate of construction was determined along with the possibility of controlling the temperature regime of the ice-soil elements for the purpose of controlling their state of stress and strain. The greatest difficulties in formulating the problem for study were assigning the boundary condition on the surface of the freshly placed saturated layer. The real possibility of a comparative analysis of various designs was demonstrated on the basis of numerical modeling of thermal processes in structures, their elements, and also when performing various technological operations. A considerable improvement of designs and methods of constructing frozen-type dams by using these techniques was substantiated. (Baker-IVI) W85-00457

DYNAMIC STRENGTH OF COHESIONLESS

SOILS,
A. G. Chernilov, B. D. Chumichev, and Sh. B.
Mukhamedaminov.
Hydrotechnical Construction, Vol. 16, No. 5, p
248-254, May, 1982. 4 Fig. 1 Tab, 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 11-14, May, 1982.

Descriptors: *Cohesionless soils, *Soil strength, Strength, Dynamics, Soil properties, Earthquakes, Hydraulic enginering, Hydraulic structures, Con-

When estimating the dynamic stability of earth structures and foundations during earthquakes, de-termining the effect of cyclic alternating loads on termining the effect of cyclic alternating loads on the strength parameters of soil is problematic. While various studies suggest that soil strength parameters are practically independent of the type of loading, the method used to process the experi-mental data seems extremely important to the final outcome. To check the effect of cyclic loading on the strength parameters of cohesionless soils, two devices for studying the strength and deformation characteristics of sand and coarse-fragmental soils under static and dynamic loads were created. Each device consists of a stabilometer, hydraulic pulsa-

tor, and a control panel which permits assigning, regulating, and monitoring the parameters of the experiments. Despite the practical equality of the ultimate intensities of shear stresses and parameters of the yield condition in static and cyclic regimes of loading cohesionless soils, an analysis of their deformability shows that cyclic loading leads to the development of considerable additional increments of both volume and shear strains. The development of additional plastic shear strains leads to a considerable decrease of the dynamic shear modulus with respect to the static, which is exhibited especially clearly for loose and moderately compact cohesionless soils. An accumulation of additional volume strains as a result of cyclic loads on soils can lead to the development of a considerable dynamic pore pressure during cyclic loading of soils and, as a consequence, to a decrease of effective stresses. (Baker-IVI)

DENSITY OF PLACING SAND-GRAVEL AND PEBBLE SOILS IN DAMS,

Hydrotechnical Construction, Vol. 16, No. 6, p 324-328, June, 1982. 4 Fig, 1 Tab, 11 Ref. Translated from Gidroteckhnicheskoe Stroitel'stvo, No. 6, p 28-30, June, 1982.

Descriptors: *Cohesionless soils, *Dam construc-tion, *Sand, *Gravel, *Nurek Dam, Construction, Design criteria, Soil types, Soil properties, Densi-ty, Hydraulic engineering.

An analysis of world dam construction practices shows that the required relative density of cohesionless soils in dams is presently J(sub-D)=0.7-0.9. In order to better define these requirements during the construction of the Nurek Dam, investigations of the compaction of pebble soils of particle-size distribution and evaluation of the effect of the degree of compacticion of their prechasion. the degree of compaction on their mechanical characteristics were carried out. It is most rational to compact gravel-pebble and sand-gravel soils in dams to a relative density of J(sub-D)=0.8. Increasing the relative density from this indicated control level leads to a marked increase in energy expenditure on con-pacting the soil. A lower than control level leads to a marked increase in energy expenditure on conpacting the soil. A lower than suggested relative density leads to incomplete use of the strength and deformation properties of the soil. Such deviations require adjustments in the design. It is necessary to consider that the investigated soils, generally, contain silt and clay particles, and therefore have an optimum moisture content whose value can be determined experimentally. In the absence of experimental values of the extreme density, the dry density of gravel-pebble and sand-gravel soils can be assigned on the basis of their actual values in nature. (Baker-IV)

USE OF LOW-STRENGTH SOILS FOR CONSTRUCTING DAMS,

V. G. Mel'nik.

Hydrotechnical Construction, Vol. 16, No. 8, p 442-452, August, 1982. 4 Fig. 3 Tab, 7 Ref. Trans-lated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 31-37, August, 1982.

Descriptors: *Soil properties, *Dam construction, Hydraulic engineering, Weathering, Argillites, Siltstone, Shale, Stability, Dam stability, Safety.

Low strength soils can be divided into four classes according to their construction properties. The first two classes of these materials have high strength characteristics, practically equivalent to strong rocks, and are suitable for placement in the shoulders of dams without restrictions. Materials of Class III can be used both in shoulders and in watertight elements of dams. To obtain high characteristics of low strength soils it is necessary to place them in the structure with a high degree of density, not less than 0.9, which in absolute density figures is 1.85-2.0 tons/cu m, depending on the particle size distribution of the soil. The soil should be placed in the dam by the method of layer-by-layer rolling in layers of 0.4-0.6 m with an average optimal moisture content of 8-12% depending on

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the content of fine earth. Slope stability of dams on a strong foundation is provided when the gradient of the slopes is equal to 2 and flatter. The deformations of dams of low strength soils depend on the degree of compaction, and for a relative density greater than 0.9 the settlements of the construction period will not exceed 6% of the height and of the operating period 19%. Weathering of well compacted low strength soils of classes I, II, and III has practically no effect on the stability and deformability of dams constructed of these materials. Weathering occurs only from the surface of the terror of the terror. practically no effect on the stability and deformability of dams constructed of these materials. Weathering occurs only from the surface of the structure to a depth of not more than 3 m and can be estimated by a formula which is provided. The experience of using argillites, siltstones, and shales showed the possibility of their year-round, highly effective placement and in all investigated cases made it possible to obtain a substantial savings due to the use of materials presently available, the reduction of the distance of hauling soil, a reduction in the volume of the dam in the case of using low strength materials with high strength characteristics analogous to rocks, and the protection of the environment from dumping of previously unused soils. (Baker-IVI)

STABILITY OF SLOPES OF CONSTRUCTION CUTS IN RUBBLE SOILS, A. V. Kolichko, and A. V. Andrianov. Hydrotechnical Construction, Vol. 16, No. 8, p 452-455, August, 1982. 1 Fig. 2 Tab, 4 Ref. Translated from Gidrotekhicheskoe Stroitel'stvo, No. 8, p 37-39, August, 1982.

Descriptors: *Slopes, *Stability, Soil properties, Slope stability, Foundation, Roads, Hydraulic engineering, Construction.

A substantiated increase in the steepness of slopes of foundation pits and road cuts has a considerable effect on reducing the time and cost of constructof foundation pits and road cuts has a considerable effect on reducing the time and cost of constructing hydraulic structures. The angles of stable alopes for loose and cohesive soils are usually calculated from the data of laboratory investigations, but for coarse-fragmental soils such investigations are either extremely costly or practically impossible. The state of upper slopes of roads and small pits of deposits of construction materials excavated at various locations in Uzbekistan, Tadzhistan, and Kirgiz was analyzed. Several generalities were revealed as a result of processing the data on existing slopes in rubble talus and proluvial soils and densely consolidated alluvial gravels. The steepness of the slopes decreases with increases in their height, however, up to a height of 2-3 m the steepness of slopes is practically independent of height. The main factors disturbing the stability of slopes are erosion, rockfalls, small collapses, and more rarely landslide phenomena. In this case the slopes of rented toward the north and northeast are subjected to a greater degree to exogoin than slopes criented toward the north and northeast are subjected to a greater north and northeast are subjected to a greater degree to erosion than slopes oriented toward the south and southeast. In addition, higher slopes are subjected to greater erosion. The erosion processes are displayed most intensely during the first 5-7 years of existence of the slopes, but these processes do not have a substantial effect on normal operation of the investigated slopes. (Baker-IVI) W85-00482

EFFECT OF ARCH SHAPE ON THE PER-FORMANCE OF A HIGH ROCKFILL DAM, A. A. Belyakov. Hydrotechnical Construction, Vol. 17, No. 9, p 444-448, September, 1983. 4 Fig. 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 19-22, September, 1983.

Descriptors: *Rockfill dams, *Dam construction, *Arching, Canyons, Dam construction, Design cri-teria, Hydraulic engineering, Cracking, Stress anal-

When constructing high earth dams in narrow canyons the danger arises that unloading in the dam body as a consequence of the arching effect between the walls can lead to hydraulic fracturing of the watertight core. The solution of three-dimensional problems of the stress strain state of a

rockfill dam in a plastic formulation under conditions of stepwise construction and filling of the reservoir permits evaluating the effect of the arch shape on the stress state of the dam and crack resistance of its core. A dual effect of arching on the stress state of the core is noted. The thrust occurring increases the level of normal stresses in the core and, on the other hand, the transverse component of the load from the water pressure of the upstream pool on the arched upstream face reduces the level of normal stresses near the wall abutments. The ocurrence of thrust is more perceptible near the steeper wall and in the lower part of a dam, where the distance between walls is less. In the upper part of a dam a positive effect of arching on crack resistance of the core is not noted. The results obtained for a 335 m high dam in a canyon with a site coefficient of 2 with a slightly inclined core permit recommending optimal arching with a rise of 50 m on the crest, which amounts to 0.068 of the crest length of the dam and corresponds to an arch with a central angle of 34 degree 1. (Baker-IVI) W85-00491

EARTH DAM OF THE AL-HADITHAH HY-DROPOWER DEVELOPMENT ON THE EU-PHRATES RIVER,

N. M. Kamnev, N. A. Sonichev, and N. A. Malyshev.

Hydrotechnical Construction, Vol. 17, No. 10, p 530-533, October, 1983. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 38-41, October, 1983.

Descriptors: *Water resources development, *Dam construction, *Earth dams, *Al-Hadithah, *Iraq, *Euphrates River, Hydroelectric plants, Power-plants, Hydraulicking.

Construction of the Al-Hadithah hydropower development on the Euphrates River in Iraq began in 1977, including an earth dam and hydroelectric station combined with an overflow spillway, indoor electrical equipment and an administration building. The earth dam was designed considering the availability of local building materials in sufficient amounts. The existing large quarries of the sand-gravel mixture made it possible to use the hydraulicking method of excavation and delivery to the dam or to intermediate stockpiles with subsequent dry blacement in the dam. The abutment to the dam or to intermediate stockpiles with subsequent dry placement in the dam. The abutment of the mealy dolomites to the sand-gravel mixture is made without transition layers. An asphaltic concrete cutoff wall is provided for in the central dolomite part of the dam separating the central dolomite part into upstream and downstream parts. The mealy dolomites on compacting with an optimal water content have good structural bonds due to the large content of fine earth. The shoulders of the dam are made of sand gravel soils characterized by considerable nonuniformity, with an average particle diameter from 0.24 to 16.7 mm, and coefficient of uniformity from 4 to 300 and higher. age particle diameter from 0.24 to 16.7 mm, and coefficient of uniformity from 4 to 300 and higher. A reinforced concrete gallery with inside dimensions of 4 x 4.5 m is provided for in the foundation of the earth dam with a length of 100 m on the right bank and 500 m in the river channel. The and some and sour in the river channel. The asphaltic concrete cutoff wall rests on the roof of the gallery. The variable depth grout curtain under the dam is two rows with a distance of 1.5 m between rows and a distance of 3 m between holes in the rows. (Baker-IVI) W85-00505

8E. Rock Mechanics and Geology

GUIDELINES FOR INSPECTION OF DAMS FOLLOWING EARTHQUAKES.

United States Committee on Large Dams, New

Report, August, 1983. 40 p, 2 Append.

Descriptors: *Dam inspection, Earthquakes, *Earthquake engineering, Disasters, *Earthquake damage, *Dam failure, *Dam breaches, Earth movements, Shock waves, Stress.

This publication was prepared by the Earthquakes Committee of the United States Committee on Committee of the United States Committee on Large Dams (USCOLD) to provide a guide for the inspection of dams following an earthquake. In-spection immediately following an earthquake is most crucial to decisions regarding continued op-eration of the structure. A followup inspection will provide more detailed information on structural performance under seismic loading. Inspection re-quirements for a dam can be made more meaning-til but salicing them for a presific due wise the performance under seismic loading. Inspection requirements for a dam can be made more meaning-ful by tailoring them for a specific dam using these guidelines. There are two phases to such an inspection procedure: (1) an immediate inspection by the dam operator (dam tender), and (2) a followup inspection by dam engineering professionals. These procedures apply if an earthquake occurs or one has been reported to have occurred with a Richter magnitude of 4.0 or greater within a 15-mile radius, 5.0 or greater within 30 miles, 5.0 or greater within 50 miles, 7.0 or greater within 80 miles, or 3.0 or greater within a 125-mile radius from the site. One appendix lists the intensity numbers for the Modified Mercalli Intensity Scale of 1931 (Abridged); a second appendix details inspection checklists to be used following an earthquake. W85-00043

METHOD OF CALCULATING THE STABILITY OF ROCK SLOPES OF HYDRAULIC STRUCTURES, E. G. Gaziev, and V. I. Rechitskii.

Hydrotechnical Construction, Vol. 16, No. 1, p 30-36, January, 1982. 3 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 26-29, January, 1982.

Descriptors: *Stability analysis, *Dam construc-tion, *Rocks, Safety, Dam stability, Slope stability, Mathematical equations, Dam foundations. Mathematical equati ons, Dam fou

The reliability of rock masses which are the foundation of structures or the enclosing medium determines to a considerable extent the reliability and safety of these structures. Methods are proposed for calculating and analyzing the stability of rock slopes. These methods make it possible to obtain reliable results with consideration of the possible characters of failure and degrees of reliability of the initial information. These methods were widely used in practical calculations of the stability of rock masses and slopes when planning stabilization measures to be used in the reservoirs of the Tolorossy and Zaramag dams, Akhuryan dam, when investigating and designing the lock of the Dnepr-2 hydroelectric station, and when investigating and designing the Middle Enisei storage station along with the Southern Ukraine power complex. (Baker-IVI) WRS MAIN

USE OF WEAK ROCKS IN DAM CONSTRUC-

M. V. Vitenberg, and V. G. Mel'nik

Hydrotechnical Construction, Vol. 16, No. 2, p 47-56, February, 1982. 9 Fig, 2 Tab, 19 Ref. Translat-ed from Gidrotechnicheskoe Stroitel'stvo, No. 2, p 4-10, February, 1982.

Descriptors: *Earth dams, *Rock properties, Construction materials, Sedimentary rocks, Metamorphic rocks, Costs, Compaction.

The requirements imposed on rock material of earth dams have changed along with the development of civil engineering techniques for the excation and compaction of materials and expansion and refinement of knowledge about the behavior of soils in dams. The use of low strength sedimentary or metamorphic rocks significantly reduced the cost of earth dam construction. Soft soils are currently finding wide use in dam construction with their rational use in many cases permitting not only a substantial reduction in cost but also in time for constructing the dams. Depending on the properties of the initial rock and technology of excavating and compacting the material, soils from soft rocks (agrillites, silistone, shales) can be placed in various elements of dams including shoulders, transition sections, cores, and blankets. The experience of using soft soils in dam construction shows that

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such soils compact well and in a compacted state have high strength properties, comparable to the characteristics of rock fill of strong hard rocks. (Baker-IVI)

STRENGTH OF INFILLED ROCK FILL,

O. A. Pakhomov. Hydrotechnical Construction, Vol. 16, No. 4, p 213-217, April, 1982. 4 Fig. 3 Tab, 6 Ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 20-23, April, 1982.

Descriptors: *Construction materials, *Strength, *Rock fill, Earth dams, Testing procedures.

Investigations of unstrengthened and strengthened materials using a large testing device confirmed earlier conclusions concerning the effectiveness of filling in rock fill for increasing the strength of earth masses. Use of noninfilled and infilled roundearth masses. Use of noninfilled and infilled rounded stone broadens the area of use of boulders and
cobble in construction, where presently such material is graded out. The low compressibility and
high shear strength of infilled rock fill may allow
its wider introduction into hydrotechnical construction if strenthening of the shoulders by infilling is mastered. A wide range of laboratory, field,
and theoretical investigations is needed. It is
stressed that filling in rock fill complicates the
technological process and should be technically
and economically justified and coordinated with
the local construction conditions. (Baker-IVI)

SOME FACTORS AFFECTING VERTICAL DIS-PLACEMENTS OF THE FOUNDATION OF THE INGURI ARCH DAM,

G. Kh. Khakimova. Hydrotechnical Construction, Vol. 16, No. 4, p 229-233, April, 1982. 3 Fig. 3 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 4, p 36-38, April, 1982.

Descriptors: *Arch dams, *Foundation rocks, *Vertical displacement, Rocks, Dam construction, Hydroelectric plant, Inguri Hydroelectric Station,

The arch dam of the Inguri hydroelectric station with a height of 271.5 m and crest length of 758 m is being constructed under complex conditions in a region characterized by a high background seismicity. The foundation is composed of limestones, dolomitized limestones, and dolomites, the beds of which have a steep monoclinal dip toward the lower pool. Foundation rocks are strong but severely fractured with moduli of deformation in discharge zones from 4-8 GPa and less and in zones of natural preservation to 13 GPa and more. A rise in the dam foundation during filling of the reservoir was noted and studies have shown that the rise occurs because under certain hydrogeological conditions the state of stress and strain of a rock foundation of a dam depends on the seepage forces and this must be taken into account when examining the interaction of the dam and foundation. (Baker-IVI) W85,00455

CONSIDERATION OF YIELDING OF A ROCK FOUNDATION WHEN CALCULATING ARCH

G. K. Gabrichidze, and L. M. Izashvili Hydrotechnical Construction, Vol. 16, No. 5, p 246-248, May, 1982. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 9-10, May,

Descriptors: *Yield equations, *Arch dams, *Foundations, Vogt method, Dam construction, Model studies, Rock mechanics, Rocks.

When calculating various effects of arch dams, the when calculating various effects of arch dams, the well known Vogt method is widely used to ac-count for yielding of the rock foundation. The basic principles of the method are: the foundation is regarded as elastic, homogeneous, and isotropic; the displacements of the rock foundation regard-less of the shape of the canyon are determined on

the assumption of the effect of reactive loads on a semi-infinite solid; Vogt's formulas in combination with the procedure developed by the U.S. Bureau of Reclamation are used for determining displacements of the rock foundation. The first two principles have a clear physical significance and the area of their use can be determined rather distinctly. The procedure for using Vogt's formulas is seen as somewhat insufficiently argued in the technical literature. A comparison is made with the use of Vogt's method showing that consideration of yielding of the rock foundation by the method on the assumption of an elastic, isotropic, and homogeneous canyon having gently sloping walls gives a satisfactory qualitative picture of the distribution of the reaction force on the contact of the dam with the rock foundation, under the effect of the hydrostatic pressure of water. The quantitative difference of the results obtained by two methods of calculation have reached 60% at some points. (Baker-IVI)

USE OF THE PROBABILISTIC METHOD OF CALCULATING STABILITY WHEN DESIGN-ING ROCK SLOPES.

V. I. Rechisskii. Hydrotechnical Construction, Vol. 16, No. 6, p 312-317, December, 1982. 3 Fig. 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 21-24, June, 1982.

Descriptors: *Slopes, *Design criteria, Rocks, Decision making, Hydraulic engineering, Dam construction, Construction, Stability.

A new method is proposed for calculating the stability of rock slopes based on the use of a statistical probabilistic method of processing the statistical productions to method of processing the measurements of orientations of potential shear joints and taking as the criterion of stability of slopes their reliability value. The practical use of the method when designing the rock slopes of foundation pits of the Southern Ukraine power compiler showed the advantages and property of foundation pits of the Southern Ukraine power complex showed the advantages and prospects of the probabilistic approach to estimating the stability of masses. In particular, use of the method made it possible to design some steeper slopes, which as a whole for the complex will permit avoiding additional excavation of tens of thousands of cubic meters of rock. The results of calculating slope stability for various values of the hydrostatic pressure indicate the need for receival investigations. sure indicate the need for special investigations to determine the shape of the line of seepage in masses and the expediency of refining this line during excavation. (Baker-IVI)

W85-00468

CALCULATION OF THE PARTICLE-SIZE DISTRIBUTION OF BLASTED ROCK,
R. Ya. Strausman, and V. M. Borychev.
Hydrotechnical Construction, Vol. 16, No. 6, p
328-332, June, 1982. 2 Fig. 4 Tab, 2 Ref. Translated
from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p
0.32 30-32, June, 1982.

Descriptors: *Hydraulic engineering, *Dam construction, *Blasting, Rock fill, Particle size, Explo-

In hydrotechnical construction one of the impor-tant requirements imposed on the quality of blast-ing is the provision of a prescribed particle-size distribution of the blasted rock. This requirement is especially important when preparing material for filling the shoulders of rock-fill dams, when the particle-size distribution of the material should meet the conditions of maximum density of placing the rock. The existing instructions on calculating charge for a prescribed degree of crushing contain substantial errors with respect to the values of the calculated coefficients and do not consider the canditions of distributing the explosive charge in the rock mass being blasted. Among the many factors influencing the degree of crushing of rocks by a blast in the zone of the hole charge, the most important is the basic powder factor, which deter-mines the amount of energy transmitted to the rock on detonating the charge. The optium diameter of the hole and the corresponding parameters of the arrangement of the charge and the main indices of blasting operations, such as the powder factor and size of the average piece of blasted rock, are determined by calculation by the given program for conditions of multirow short-delay blasting. (Baker-IVI) W85-00471

METHODOLOGICAL PRINCIPLES OF AN ON-SITE STATISTICAL POINT ESTIMATION OF THE PARTICLE-SIZE DISTRIBUTION OF A ROCK MASS, V. A. Kuznetsov

V. A. Kuznetsov. Hydrotechnical Construction, Vol. 16, No. 7, p 420-426, July, 1983. 5 Fig, 3 Tab, 5 Ref. Translated from Gidretekhnicheskoe Stroitel'stvo, No. 7, p 47-50, July, 1982.

Descriptors: *Rocks, *Particle size, *Dam construction, Evaluation, Decision making, Construction, Hydraulic engineering.

The particle-size distribution is the most important characteristics of a lumpy rock mass, determining the strength and seepage properties of rockfill structures and also the effectiveness of blasting, excavating, transporting, and other mining and construction work. An on-site statistical point esticonstruction work. An on-site statistical point estimation was devised which can be carried out on the surface of blasted rock piles, on the slopes of dumps, and on the surface of natural rock falls and slides. The method is distinguished by simplicity, promptness, and comparatively small labor intensity while providing a high accuracy of results. The main works in the method include selection of the sizes of the fractions being recorded, inspection of the rock pile making a diagrammatic representation of it and selection of the measuring areas and profiles, taking statistical samples, estimates, and auxiliary measurements, and processing and transprofiles, taking statistical samples, estimates, and auxiliary measurements, and processing and transforming the results. To increase the accuracy of estimating the size distribution it is recommended to originally determine the content of the fraction for each measuring area and then to calculate the weighted average value with respect to the volumes of the rock pile corresponding to individual areas. The following distortion factors must be kept in mind: the armor effect - sieving of the fine fractions through larger fractions, leading to an overestimation of the content of large fractions in the surface layer of the pile; the effect of incomplete visibility of the rock lumps during estimation; and local accumulations of oversize in certain zones of the pile and segregation of the rock mass on steep slopes. (Baker-IVI)

8F. Concrete

PERMEABILITY OF GROUT SEALS SUR-ROUNDING THERMOPLASTIC WELL

ROUNDING
THERMOPLASTIC WELL
CASING,
Auburn Univ., AL. Dept. of Civil Engineering.
C. E. Kurt, and R. C. Johnson, Jr.
Ground Water, Vol. 20, No. 4, p 415-419, JulyAugust, 1982. 5 Fig, 9 Ref. OWRT project A-076ALA.

Descriptors: *Grouting, *Permeability coefficient, *Well casings, Thermoplastics, Plastics, Cements, Calcium chloride, Bentonite.

An experimental test program was conducted to measure the longitudinal permeability of a grouted thermoplastic water well casing system. A neat cement grout, with and without calcium chloride cement grout, with and without calcium chloride or bentonite admixtures, was placed in the annulus of a simulated well. Test pressure and specimen configuration was shown to influence the measured coefficient of permeability. A neat grout with a water/cement ratio of 2.0 had a much higher permeability coefficient than the same grout with a water/cement ratio of 0.46. Once the bond line between the grout and casing was broken, the permeability of the system was generally higher than for the initial test. Specimens with a bell coupling included had a slightly higher permeability than specimens with straight pieces of casing. The effect on permeability of the admixtures in the grout was not conclusive. However, the addition of a bentonite slurry to the test water was observed

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to decrease the permeability coefficient when tested under low pressure. The permeability coefficient of the basic neat grout casing system ranged from 0.0002-0.0010 cm/sec at low test pressure. It was concluded that the casing has an impact on the longitudinal permeability of the system since the coefficients of permeability measured were significantly higher than other published values. However, the coefficients of permeability measured were in the range of soils with low permeability such as sitts. (Moore-IVI)

CONCRETING THE DIVERSION DEWATER-ING OUTLETS OF THE ZEYA HYDROELEC-TRIC STATION.

ING OUTLETS OF THE ZEYA HIDROELEC-TRIC STATION, Ya. P. Mirzaev. Hydrotechnical Construction, Vol. 16, No. 1, p. 8-12, January, 1982. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p. 12-14, January, 1982.

Descriptors: *Dam construction, *Spillways, *Concrete, *Zeya Hydroelectric Station, *USSR, Cantilevers, Portals, Hoists, Hydraulic equipment.

Cantilevers, Portals, Hoists, Hydraulic equipment. During construction of the Zeya hydroelectric station, diversion of the river past the concrete structures of the spillway part of the dam was accomplished by a three stage scheme. In the first stage the design discharge of 1% probability, equal to 14,500 cubic m/sec, was discharged through four 23-m wide bays of the comb and two 8 m wide extreme bays. On the upstream and downstream sides the comb is closed by slide gates by means of a gantry crane from the downstream pool and by hoisting gear from the upstream pool. As the dam was created the comb was reconstructed into 10 dewatering outlets of the first phase. The use of poured concrete with plasticizer GKZh-94 in difficult to access parts of structures, such as the plug of dewatering outlets, is effective with respect to the conditions of delivering the concrete to the placement site and considerably reduces labor expenditures on its compaction. The overconsumption of cement for poured concrete is compensated for by the reduction of labor expenditures on delivering the concrete mix to the placement site and its compaction. Under conditions of Siberian rivers with large diversion discharges, it is necessary to have several sets of mechanisms and equipment for closing the outlets - hydraulic hoists, cantilevers, portals, rods, guard gates - for increasing the rate of construction and eliminating downtimes in unforeseen or emergency situations. (Baker-IVI)

USE OF STEEL FIBER-REINFORCED CONCRETE FOR GROOVE ELEMENTS OF GATES, A. R. Freishist, and D. G. Yaroshenko. Hydrotechnical Construction, Vol. 16, No. 3, p 175-177, March, 1982. 3 Fig, 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 49-50, March, 1982.

Descriptors: *Reinforced concrete, *Steel, *Hydraulic gates, Concrete, Construction, Dams, Gates, Bearings, Stress.

Gates, Bearings, Stress.

The possibility of using steel fiber-reinforced concrete for the groove elements of gates was examined during investigations of heavily loaded slide bearings of vertical lift gates at the Nurek hydroelectric station conducted for the purpose of finding a rational method of transmitting the load from the track to the concrete. Prior to this time, volume-dispersed reinforcement by segments of steel wire or steel shavings was sometimes used for offset concrete for embedded parts of the main pivots of radial gates of hydraulic structures. The bearing capacity of the concrete based under the rail with various reinforcement methods was compared during the study. The state of stress of the concrete base of the groove element under a load was investigated with two configurations of rails. Failure of the concrete in all cases occurred before the occurrence of plastic deformation in the rail. The fragments of steel fiber reinforced concrete withstood a load on the average 30% higher than the fragments with meshes and 80% higher than the concrete fragments without reinforcement, in

dicating the prospects of using steel fiber-reinforced concrete in the groove elements of gates. The dependence of the mechanical characteristics of steel fiber-reinforced concrete on the character of reinforcement was then studied. In all cases failure of the steel fiber reinforced concrete specimens was preceded by the development of a dense network of fine cracks. (Baker-IVI) W85-00446

CAST CONCRETES WITH FROSTPROOFING ADDITIVES IN UNDERGROUND CONSTRUCTION

TION, R. P. Burba, E. M. Glazunov, A. I. Matyukhina, and M. V. Zaitsev. Hydrotechnical Construction, Vol. 16, No. 5, p 283-288, May, 1982. 7 Fig. 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 31-34, May, 1982.

Descriptors: *Concrete, *Construction materials, *Strength, Reinforced concrete, Temperature effects, Frost protection, Underground structures.

fects, Frost protection, Underground structures. Cast concretes with frostproofing additives are most effective when constructing elements with unlimited striking times at negative ambient temperatures not below minus 15 degrees. Sodium nitrite-nitrate and phosphated calcium chloride are recommended for cast concrete with fine sands. Phosphated calcium chloride is most effective in cast fine-sand concrete for constructing unreinforced structures in the case of alternating and moderately negative ambient temperatures. Sodium nitrite-nitrate is most effective in cast concrete shardening at lower temperatures when constructing both reinforced and unreinforced elements of underground structures. These additives plasticize the cast concrete mix, increasing the cone alump within 25 to 45%. The strength of cast fine sand concretes with frostproofing additives, at least for a low water/cement (W/C) ratio of not less than 0.4, obeys the regularities established for high and low slump mixes and correlates with the W/C ratio with respect to the known relations. The replacement of medium sand by fine in cast mixes of equal strength increases the content of cement by 10-15%, just as in stiff and plastic concretes of equal flowability and equal strength. The strongest combinations of frostproofing additives, which include ammonia water, cannot be used under underground conditions owing to toxicity upon evaporation. (Baker-IVI)

SELECTION OF ECONOMIC THICKNESSES OF REINFORCED-CONCRETE ELEMENTS OF HYDRAULIC STRUCTURES,

HTDRACIAC STRUCTURES, I. P. Pomazueva. Hydrotechnical Construction, Vol. 16, No. 5, p 292-293, May, 1982. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 49-50, May, 1982.

Descriptors: *Reinforced concrete, *Economic aspects, Construction materials, Decision making, Concrete.

Massive reinforced-concrete elements are finding wide use in hydrotechnical construction. The amount and cost of construction and assembly works of such elements are considerable, and the search for more advantageous solutions when designing the plants will produce a perceptible economic benefit. A variety of equally strong reinforced concrete cross sections with different thicknesses and reinforcement can be selected for use based on job specifications. The costs of equally strong reinforced concrete elements has been analyzed as a function of their thickness and reinforcement for a number of power facilities being constructed in Central Asia. The economic effectiveness of the element increased with decreases of the grade of concrete. An increase of the concrete grade does not allow reducing the amount of reinforcement enough to obtain an economic effect for the element as a whole. The selection of the class of reinforcement does not affect the results of the analysis. Preference should be given to reinforcement of a higher class. In eccentrically compressed reinforced-concrete elements there is a direct rela-

tion between the decrease of cost of the element and the decrease of its thickness. In the case of eccentric compression with very large eccentrictities, when the compressive force can be neglected, the regularities characteristic for flexural elements come into force. (Baker-IVI)

EVALUATION OF THE EFFECTIVENESS OF MEASURES TO SHORTEN THE CONSTRUCTION TIME OF MASS CONCRETE STRUCTURES OF HYDROELECTRIC STATIONS, For primary bibliographic entry see Field 6B. W85-00476

CREEP OF CONCRETE UNDER MULTIAXIAL COMPRESSION,

E. A. Kogan.

Hydrotechnical Construction, Vol. 17, No. 9, p 448-452, September, 1983. 4 Fig. 1 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 22-25, September, 1983.

Descriptors: *Concrete, *Creep, *Dam construction, *Compression, Multiaxial compression, Elasticity, Linear creep, Stress analysis, Poisson Ratio.

The characteristics of elasticity and creep of mature concrete under uni-, bi-, and triaxial compression in the region of linear creep do not depend on the type of stress state and can be determined in ordinary uniaxial experiments. The assumption of equality of Poisson's ratios of elastic strains and creep and their constancy in time made in the linear theory of an elastically creeping body is admissible. The usual assumption of independence of the action of forces in various directions with consideration of Poisson's strains is confirmed by experiments with the long action of time constant compressive stresses not exceeding 30-40% of the ultimate strength. (Baker-IVI)

INTENSE METHODS OF WINTER CONCRETING OF UNDERGROUND HYDRAULIC STRUCTURES IN THE FAR NORTH,

E. M. Glazunov, A. I. Matyukhina, M. N. Rozin, and V. A. Rumyantsev.

Hydrotechnical Construction, Vol. 17, No. 9, p 463-466, September, 1983. 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 35-37, September, 1983.

Descriptors: *Dam construction, *Cold weather construction, *Concrete, Hydraulic engineering, Construction materials, Additives, Costs, Gunite, Formwork.

A specific feature of the technology of constructing linings of underground structures in regions of the Far North is the need to create conditions for hardening of concrete at low natural temperatures of the air and surrounding rocks. Methods for concreting tunnels are proposed for these regions which make it possible to reduce energy expenditures several fold, increase the rate of constructing linings by 1.5 to 2 times, to reduce total labor expenditures fo 2.0 to 2.5 times, and to reduce expenditure of manual labor by 30-40%. For the wide introduction of the concreting methods developed it is necessary to considerably broaden the range of concrete additives presently used in underground construction. When designing concrete plants it is necessary to provide for special production lines for introducing these additives. Attention should first of all be given to the creation of optimal designs of thermoactive formwork with an adjustable heating regime and units for the preparation, heating, and transport of the solution of the gunite additives during construction. (Baker-IVI) W85-00494

PROBLEMS OF CALCULATING THE STRENGTH OF MASSIVE CONCRETE AND REINFORCED-CONCRETE ELEMENTS OF COMPLEX HYDRAULIC STRUCTURES,

Descriptors: *Concrete, *Strength, *Reinforced concrete, Construction materials, Dam construction, Hydroelectric plants, Hydraulic engineering.

An attempt was made to solve urgent problems of the strength of three dimensional concrete and reinforced concrete elements of a hydrostation. Solutions were sought through the selection of the cross sections of reinforcement of three directions cross sections of reinforcement of three directions on the basis of six components of the stress tensor; strengthening of concrete in compressed-extended zones of triaxially reinforced reinforced-concrete elements with consideration of the squeezing effect of tensile reinforcement; provision of strength of triaxially stressed concrete under complex loading; and strengthening of contact layers and block joints of concrete. (Baker-IVI)

8G. Materials

GUIDELINES FOR INSPECTION OF DAMS FOLLOWING EARTHQUAKES, United States Committee on Large Dams, New

For primary bibliographic entry see Field 8E. W85-00043 York.

EPOXY-BITUMEN WATER PROOFING OF HYDRAULIC STRUCTURE, V. I. Sakharov. Hydrotechnical Construction, Vol. 16, No. 5, p 274-277, May, 1982. 2 Fig. 2 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 26.98 May, 1982. 26-28, May, 1982.

Descriptors: "Pipelines, "Coatings, "Waterproofing, "Epoxy, "Bitumen, "Water distribution, Drinking water, Cracking, Leakage, Water storage, Water quality.

When constructing hydraulic and water management structures related to the passage and treatment of drinking water, the need arises for using waterproof coatings which will not harm the quality of the water. Tests were conducted on specimens of epoxy-bitumen waterproof compositions to determine the physical and mechanical properties of the coatings, their adhesion, hardness, elasticity, and crack resistance. The coatings proved acceptable both technically and economically for the passage of water, as well as its storage and treatment of drinking water. The most effective area for use of epoxy-bitumen coatings is for waterproofing thin walled non-crack resistance components and structures. (Baker-IVI)

USE OF ULTRASOUND FOR CHECKING THE FROST RESISTANCE OF CONCRETE,

A. M. Filonidov. Hydrotechnical Construction, Vol. 16, No. 5, p 278-283, May, 1982. 4 Fig. 4 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 28-31, May, 1982.

Descriptors: *Concrete, *Testing procedures, *Ultrasonics, *Frost protection, Construction materi-

Tested methods of producing concrete with a pre-scribed frost resistance have been developed, but the method of testing the resistance of the concrete is very laborious. A new method was developed for determining the frost resistance of concrete on a known design after only one freezing cycle. The method proved satisfactory for prompt checking of the quality of concrete and for evaluating the frost

resistance in structures under construction and in operation on the basis of cores. The method is operation on the basis of cores. The method is based on a comparative testing method using cali-brated relations between compressive strength, ice content, ultrasound velocity, and frost resistance of concrete of known designs. A relatively high accu-racy of determining frost resistance, equal to plus or minus 15% can be obtained in 95-98% of the cases. (Baker-IVI) W85-00462

8H. Rapid Excavation

HYDRAULICKING AT THE CONSTRUCTION OF THE ZAGORSK PUMPED-STORAGE STA-

L. A. Tolkachev, S. N. Semenenok, and A. M.

Hydrotechnical Construction, Vol. 16, No. 3, p 138-142, March, 1982. 6 Fig. Translated from Gi-drotekhnicheskoe Stroitel'stvo, No. 3, p 17-19, March, 1982.

Descriptors: *Hydraulicking, *Pumped storage, *Zagorsk Pumped Storage Station, *USSR, Construction, Earthworks, Borrow pits.

The Zagorsk pumped storage station (PSS) is the first large pumped storage station in a series of unified PSS being constructed in the central zone of the European USSR. On the basis of construction experience the following suggestions are offered. When using hydraulicking methods of constructing earthworks for pumped storage stations with borrow pits located in flood plains of rivers it is necessary to take into account the following with borrow pits located in flood plains of rivers it is necessary to take into account the following circumstances: the high inhomogeneity of borrow pits both horizontally and vertically, which precludes an estimation of the particle size distribution the basis of the average grading curve; siltation of borrow pits by clay and silt material with boulder and wood inclusions; there is no method of reliability determining the content of boulders and wood the wood inclusions; there is no method of reliability determining the content of boulders and wood inclusions over the vertical section; and the special role of small rivers in the European USSR, which compel complete isolation of the areas of hydraulicking works from the main channel. (Baker-IVI) W85-00442

8I. Fisheries Engineering

SELECTING SITES OF PROJECTED FISH

SELECTING SITES OF PROJECTED FISH PASSES, Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology. M. A. Skorobogatov, D. S. Pavlov, A. Sh. Barekyan, and L. G. Shtaf. Doklady Biological Sciences, Vol. 272, No. 1-6, p 508-510, September, 1983. 2 Fig, 5 Ref. Translated from Doklady Akademii Nauk SSSR, Vol. 272, No. 1, p 250-253, September, 1983.

Descriptors: *Dam design, *Fish passages, Fish behavior, Hydroelectric plants, Spillways, Plan-ning, Decision making, Roach, Fish migration.

One of the most important problems arisi planning of areas for fish to pass through a dam is choosing the sites of the passes in the system at the hydroelectric center. A procedure for this choice is presented based on a comparison of the probable working efficiency of a fish pass at each possible location site. Hydraulic-biological studies carried out a few years ago make it possible to ascertain the factors influencing the formation of the paths of motion of fish, as well as the reactions of fish to various flow characteristics. The behavioral fea-tures of each school of fish are taken into account by finding the deviations of the transverse and longitudinal fish velocities from the average values. In order to determine the afficiency values. In order to determine the efficiency of a fish pass for a known flow structure in the tailwater of a hydroelectric system, all possible paths of fish motion from the initial point to the entry of the fish collecting chute are calculated. As an example, the efficiency was calculated for one operating regime of a model hydroelectric center with a fish pass located in the middle of the spillway, for passage through the system of schools of roach with an average length of 25.4 mm. This approach provides an objective evaluation of the likelihood that fish will enter a fish pass and indicates the optimum location of the pass in the hydroelectric system, as well as the optimum operating regime. In order to apply this approach to specific planning operations, it is advisable to carry out studies in two possible directions: to seek small experimental fish with behavior similar to that of spawning migrants and to study the reactions of fish likely to pass through hydroeletric centers. (Baker-IVI) W85-00159

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

NISQUALLY GLACIER, MOUNT RAINIER, WASHINGTON, 1857-1979: A SUMMARY OF THE LONG-TERM OBSERVATIONS AND A COMPREHENSIVE BIBLIOGRAPHY.

Geological Survey, Tacoma, WA. Water Resources Div. For primary bibliographic entry see Field 2C. W85-00039

ANNOTATED BIBLIOGRAPHY OF REMOTE SENSING FOR HIGHWAY PLANNING AND NATURAL RESOURCES,

Connecticut Univ., Storrs. Dept. of Natural Re-

D. L. Civco, W. C. Kennard, and M. W. Lefor. Storrs Agricultural Experiment Station Bulletin No. 456, January 1980. 136 p, 152 Ref.

Descriptors: *Remote sensing, *Bibliographies, Infrared imagery, *Wetlands, *Aerial photography, *Satellite technology, *Sensors, *Telemetry, Economic aspects, Engineering, Publications, Highways, Roads.

Remote sensing is the art and science of gathering information from a distance such as from aircraft or satellites. Earth surface features and phenomena can be detected, identified, delineated and analyzed through interpretation of the imagery collected. These procedures have proven valuable in natural resource planning, environmental impact assessment, and engineering activities. The bibliography is divided into five sections, each containing abstracts, many of which deal with the subject of freshwater wetlands, as well as with color infrared photography itself. The complete citation is given for each publication abstracted, together with details on the problems, approach, equipment, results, and conclusions. Each abstract is followed by a list of keywords which indicates the subject matter of and conclusions. Each abstract is followed by a list of keywords which indicates the subject matter of the publication. In addition, an author index, a keyword index, and a list of abbreviations and keyword index, and a list of abbreviations and aeronyms used are provided. The five sections in the annotated bibliography are: (A) highways and remote sensing applications (53 abstracts); (B) environmental impact of highways and corridor selection methods (23); (C) wetlands and remote sensing applications (14); (D) economics of remote sensing applications (51). Among the abstracts related to general applications are those concerned with proposed freeway extensions, delineating forest cover types, and military geographic intelligence. (Garrison-Omniplan) plan) W85-00047

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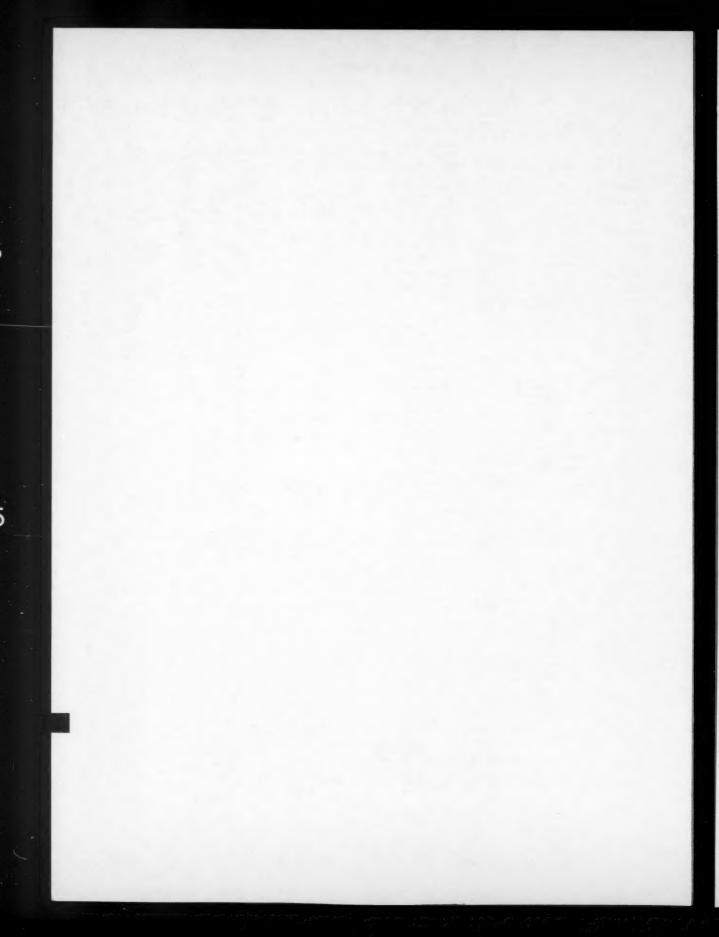
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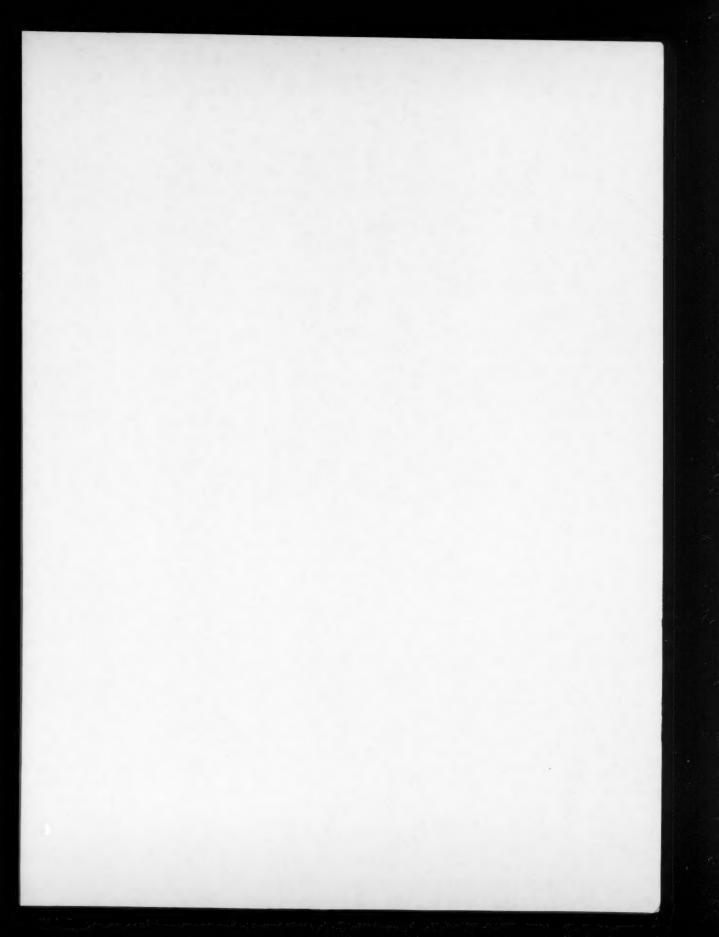
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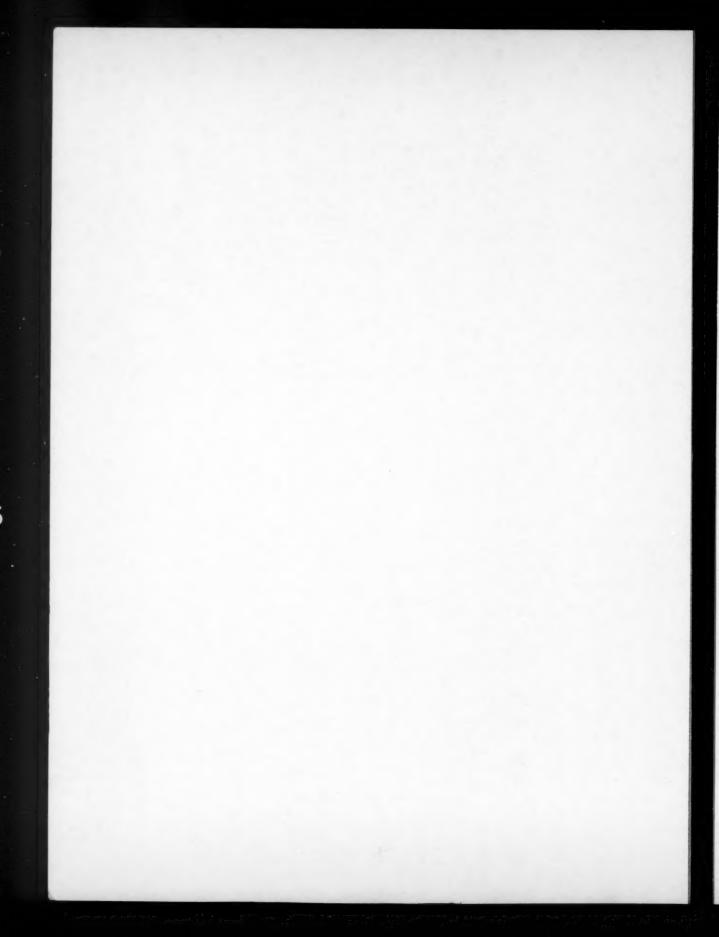
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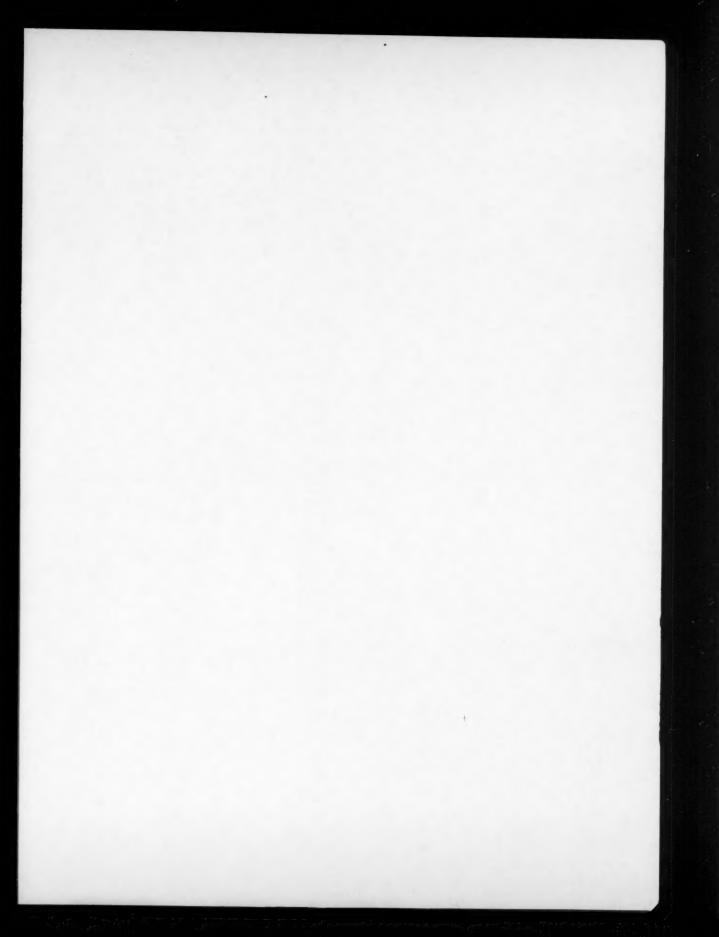
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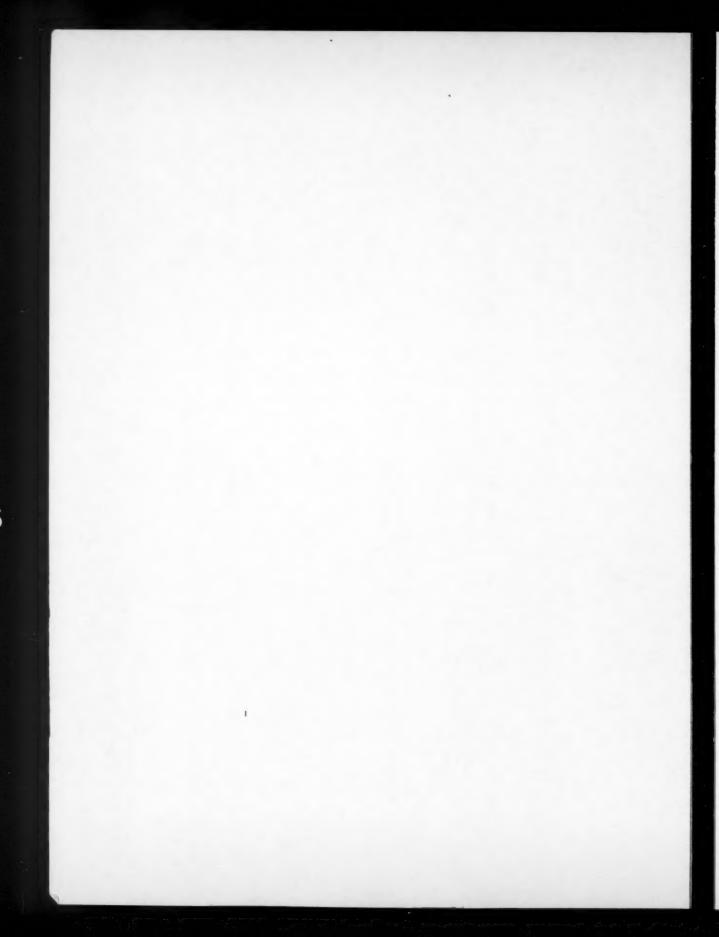
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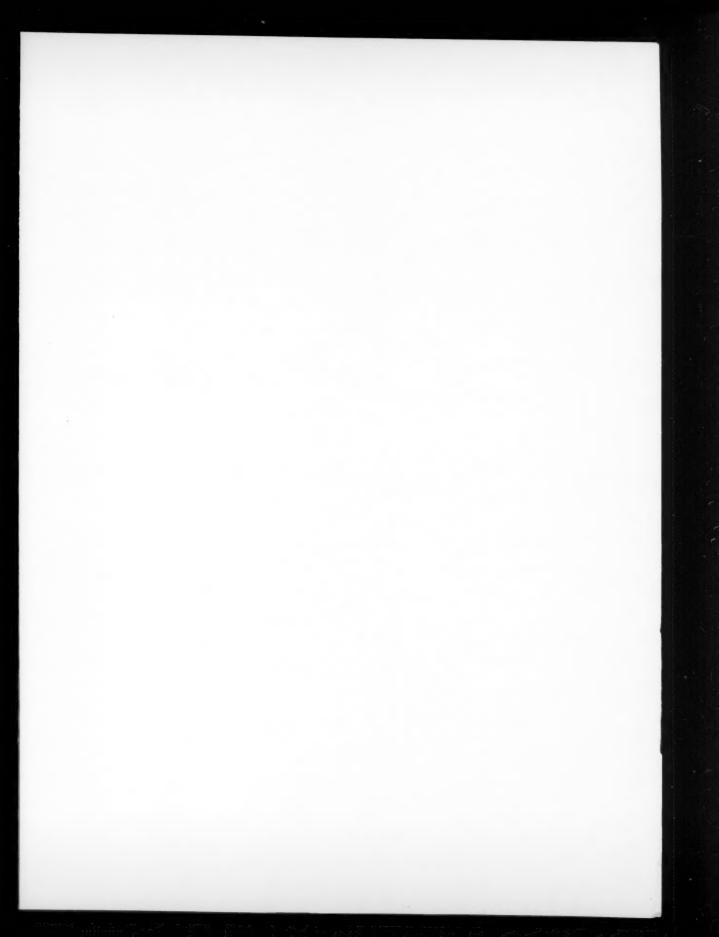
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Subject Fields

- NATURE OF WATER
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- WATER SUPPLY AUGMENTATION AND CONSERVATION
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